SOIL SURVEY OF

Cuming County, Nebraska

United States Department of Agriculture
Soil Conservation Service
In cooperation with
University of Nebraska
Conservation and Survey Division

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1965–72. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1972. This survey was made cooperatively by the Soil Conservation Service and the Conservation and Survey Division of the University of Nebraska. It is part of the technical assistance furnished to the Lower Elkhorn Natural Resources District. The Cuming County Board of Supervisors and the Lower Elkhorn Natural Resources District provided funds for preparation of the maps that are a part of this survey.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and windbreaks; 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 of the soils of Cuming 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" at the back of this survey 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 unit and windbreak suitability group to which each soil belongs. It also shows the page where each soil is described and the pages where the capability unit and windbreak suitability group are discussed.

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 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 use and management of the soils from the soil descriptions and from the discussions of the capability units and windbreak suitability groups.

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

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 in the section "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 how the soils formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers in Cuming 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 information about the county given in the section "General Nature of the County."

Cover picture: Terraces, contour farming, and a farmstead windbreak are conservation practices on this farm in the Moody-Nora-Belfore association of Cuming County.

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SOIL SURVEY OF CUMING COUNTY, NEBRASKA

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

CUMING COUNTY is in the northeastern part of Nebraska (fig. 1) and has an area of 365,440 acres,

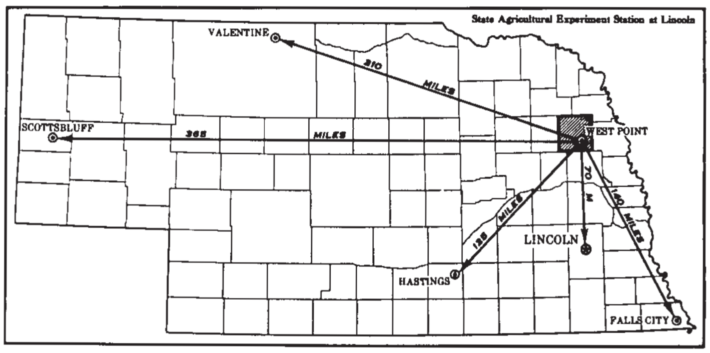

***Figure 1.*—Location of Cuming County in Nebraska.**

or 571 square miles. The landscape is principally a loess-mantled, dissected till plain, which has an altitude that ranges from 1,275 feet to 1,600 feet above sea level. On the uplands are two small areas of eolian sand. On bottom lands, alluvial soils border the streams. The Elkhorn River drains nearly four-fifths of the county and Logan Creek the remainder. Plum Creek, Pebble Creek, Cuming Creek, and Rock Creek are the principal tributaries of the Elkhorn River.

The climate is continental and has wide seasonal and daily variations. It is suitable for growing cultivated crops and grasses and for raising livestock. The long, hot summers are especially favorable for corn. In winter, occasional extreme cold can be a hardship for livestock.

The boundaries of Cuming County were defined in March 1855 by an act of the first legislature of the Nebraska territory. The first settler was Benjamin B. Moore, who built a cabin in the summer of 1857 in the area that became DeWitt. In the spring of 1858, Josiah and John McKirahan and John D. Neligh, who had been impressed with accounts they had heard of the Elkhorn River valley, came from Ohio and settled along the river 5 miles south of DeWitt in the area that became West Point. They claimed squatters rights and lived in dugouts covered with sod while building more permanent homes. Other settlers soon arrived, and local governments were formed. West Point became the county seat in 1858.

In spite of a bitterly cold winter in 1858-59 and an Indian skirmish in the summer of 1859, the settlements flourished. In June 1869, the United States Land Office moved from Omaha to West Point and the first term of the Cuming County District Court was held. A railroad was built from Missouri Valley, Iowa, to West Point in 1870 and has served the area since that time.

In 1970, the population of Cuming County was 12,034. West Point is the largest town in the county. Other towns on the Elkhorn River are Beemer and Wisner. Bancroft is in the northeastern part of the county on Logan Creek.

Raising cattle and hogs for slaughter is the principal enterprise and provides the major source of farm income. The county ranks high in the State in corn production, but more corn is fed to livestock than is grown in the county. Soybeans and alfalfa are also important crops. Small grain and grain sorghum are grown in smaller amounts. About 85 percent of the acreage is cultivated. The remaining 15 percent is in range, pasture, and woodland.

Cultural facilities include schools and churches throughout the county. One hospital, rest homes, nursing homes, and several medical clinics also are available. Recreational facilities include city parks, swimming pools, a golf course, and lighted athletic fields. Woodland, range, and wetland provide deer, quail, pheasants, and ducks for hunting. The Elkhorn River and Logan Creek provide good fishing. Some fishing is also done in gravel pits and farm ponds. Other such forms of recreation as hiking, bicycling, and bird-watching also are popular.

The first soil survey of Cuming County, Nebraska, was published in 1922 (*3*).[1] The present survey provides the additional and updated information needed because of technical advances in farming methods, engineering techniques, and soil classification. It also includes a larger map that shows the soils in greater detail.

How This Survey Was Made

Soil scientists made this survey to learn what kinds

[1] Italic numbers in parentheses refer to Literature Cited, p. 66.

of soil are in Cuming 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. In addition to collecting many facts about the soils, they observed the steepness, length, and shape of slopes, the size and nature of streams, the kinds of native plants or crops, and the kinds of rock. 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* 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. Belfore and Moody, for example, are the names of two soil series. In the United States all soils 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 layer 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, Moody silty clay loam, 2 to 6 percent slopes, is one of several phases within the Moody 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 at the back of this publication was prepared from aerial photographs.

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 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. Two such kinds of mapping units are shown on the soil map of Cuming County: soil complexes and undifferentiated soil groups.

A soil complex consists of areas of two or more soils, so intricately mixed 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. Generally, the name of a soil complex consists of the names of the dominant soils joined by a hyphen. The Lamo-Slickspots complex, 0 to 2 percent slopes, is an example.

An undifferentiated soil group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group ordinarily consists of the names of the dominant soils joined by "and." Thurman and Valentine loamy fine sands, 3 to 6 percent slopes, is an undifferentiated soil group in Cuming County.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been 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 alluvial land is a land type in this survey area.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also 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.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or to a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then 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 current 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 Cuming 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 soils in 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, or other characteristics that affect their management.

The five soil associations in Cuming County are described on the following pages. The terms for texture used in the title of the associations apply to the texture of the surface layer. For example, in the title of the Thurman-Leisy-Moody association, the words "sandy, loamy, and silty" refer to the texture of the surface layer.

The names and delineations of soil associations shown on the general soil map may not fully agree with those on the general soil maps of surveys of adjacent counties published at a different date. Differences in the maps are the result of improvements in the classification or refinements in soil series concepts. In addition, more precise maps are now needed because the uses of the general soil map have expanded in recent years.

1. Nora-Moody-Judson association

Deep, well-drained, gently sloping to moderately steep, silty soils on uplands and foot slopes

This association consists mostly of gently sloping to moderately sloping soils on divides and of moderately steep soils on hillsides bordering drainageways (fig. 2).

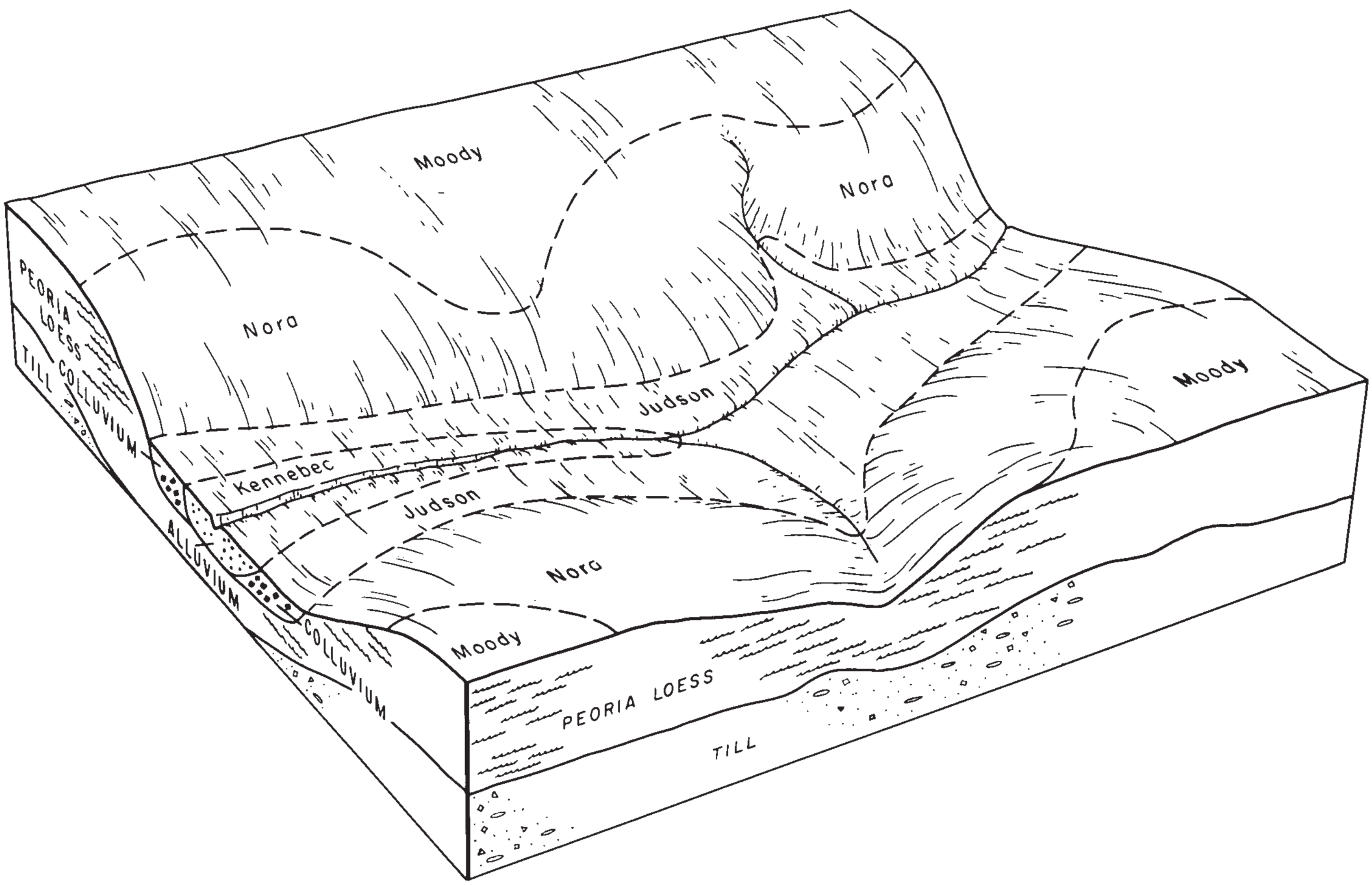

Figure 2.—Soils of the Nora-Moody-Judson association and their relationship to parent materials.

It includes colluvial soils on foot slopes along narrow upland drainageways. This association is dissected by many small intermittent drainageways that merge into larger drainageways. Relief from the bottom of a drainageway to the crest of the adjacent ridge ranges from 65 to 125 feet. Soils in this association are deep and generally are well drained.

The areal extent of this association is about 48,000 acres, or 13 percent of Cuming County. Nora soils make up about 47 percent of the association, Moody soils 26 percent, and Judson soils 12 percent. The remaining 15 percent consists of minor soils.

Nora soils are on narrow ridgetops and on hillsides adjacent to drainageways on uplands. These are moderately sloping to moderately steep, friable soils that formed in loess. The surface layer is silty clay loam and ranges from 5 to 15 inches in thickness. The subsoil is silty clay loam that is noncalcareous in the upper part and calcareous in the lower part. The underlying material is calcareous silt loam. Brown, yellowish-brown, and reddish-brown mottles occur below the surface layer.

Moody soils are on broad ridgetops and on hillsides adjacent to drainageways on uplands. They are gently sloping to moderately sloping soils that formed in loess. The surface layer is firm silty clay loam and ranges from 6 to 15 inches in thickness. The subsoil is firm silty clay loam. The upper part of the calcareous underlying material is silty clay loam, and the lower part is silt loam that has brown, yellowish-brown, grayish-brown, and gray mottles.

Judson soils are on foot slopes along narrow upland drainageways and small stream valleys. These gently sloping soils formed mostly in colluvium. The surface layer is silty clay loam that ranges from 25 to 36 inches in thickness; it is friable in the upper part and firm in the lower part. The subsoil, to a depth of 60 inches, is silty clay loam and has yellowish-brown and grayish-brown mottles.

The minor soils in this series are in the Kennebec and Colo series. They are on bottom lands and are nearly level. Kennebec soils are friable and are moderately well drained. Colo soils are friable in the surface layer and firm beneath; they are somewhat poorly drained. The water table is at a depth of 8 to 12 feet in areas of Kennebec soils and at a depth of 3 to 8 feet in areas of Colo soils.

About 75 percent of the acreage is cultivated. Corn, alfalfa, and soybeans are the principal crops. The remaining areas are in pasture. A few areas are irrigated by means of self-propelled sprinkler systems.

Farms in this association average about 250 acres in size and are diversified. They are primarily a combination of the cash-grain and livestock types. Soybeans are grown for cash. Nearly all of the grain and hay produced is fed to livestock. Many cattle and hogs are fattened in feedlots and are marketed locally through livestock buyers or livestock sale barns. A small percentage of livestock is shipped to terminal markets in large cities outside the county. The markets are easily accessible. Gravel, blacktop, or improved dirt roads are on most section lines, but there is no road on some section lines. Several State highways and one Federal highway cross the area; these are concrete or good blacktop roads.

Conserving water and maintaining good tilth and high fertility are the main concerns of management in this association. On uplands, erosion of soils is the principal hazard. In narrow valleys, local flooding is a hazard and wetness limits the use of some soils.

2. *Colo-Calco-Kennebec association*

Deep, somewhat poorly drained and moderately well drained, nearly level, silty soils on bottom lands

This association consists mostly of nearly level soils on bottom lands of the major creeks and their tributaries. The creeks are narrow and moderately deep, and those not artificially straightened have meandering courses through the bottom lands. Logan and Plum Creeks have been straightened, but many meanders of their former natural channels still are evident. During periods of heavy rainfall, the streams commonly overflow and flood the bottom lands. In most of the association, the water table is at a depth of 2 to 8 feet, though in a few places it is at the surface, and in some places it is as much as 12 feet below the surface. Soils in this association formed in silty alluvium, are deep, and generally are somewhat poorly drained to moderately well drained.

The areal extent of this association is about 47,000 acres, or about 13 percent of Cuming County. Colo soils make up about 25 percent of this association, Calco soils 19 percent, and Kennebec soils 18 percent. The remaining 38 percent consists of minor soils.

Colo soils are on stream terraces and on broad, nearly level bottom lands, mostly in the upper reaches of drainageways. They are somewhat poorly drained, noncalcareous soils that are silty clay loam throughout their profile. The surface layer is friable and ranges from 22 to 34 inches in thickness. Horizons below the surface layer have brown, reddish-brown, and yellowish-brown mottles.

Calco soils are mainly on bottom lands along the upper reaches of drainageways and creeks that are only shallowly entrenched into the landscape. They are firm, calcareous, somewhat poorly drained soils that are silty clay loam throughout their profile. The surface layer ranges from 30 to 48 inches in thickness. Brown, reddish-brown, and yellowish-brown mottles occur below a depth of 35 inches.

Kennebec soils are on the highest areas of the bottom lands of upland drainageways. They are friable, noncalcareous, and moderately well drained. The surface layer, 24 to 42 inches thick, and the transitional layer beneath it consist of silt loam. The underlying material is silt loam and silty clay loam and has yellowish-brown to brown mottles.

Minor soils in this association are in the Zook and Judson series. Zook soils are mostly in the lowest areas of bottom land along the major creeks and are somewhat poorly drained. Judson soils are on foot slopes along narrow upland drainageways and small stream valleys; they are gently sloping and well drained.

Most of the acreage is cultivated. The soils are fertile, and where wetness is not a limitation, they are suited to all crops commonly grown in the county. When rainfall is insufficient, row crops in some areas are irrigated with water from wells and streams. Some of the wet areas are planted to grass for pasture.

Farms in this association average about 300 acres in size and are diversified. They are the cash-grain type or a combination of the cash-grain and livestock types. Cattle feeding is a major enterprise in this area. Nearly all the grain and hay produced is fed to livestock or is marketed within the county. Most fattened livestock are marketed locally, but a small percentage is marketed outside the county. Markets are easily accessible. Good gravel or improved dirt roads are on most section lines, but some do not cross the creeks. Several paved or blacktop highways cross areas of this association.

Wetness related to a high water table or to flooding is the main limitation on soils in this association. The lack of adequate surface and internal drainage is the principal concern of management.

3. *Moody-Nora-Belfore association*

Deep, well-drained, nearly level to moderately steep, silty soils on uplands

This association consists mostly of nearly level to gently sloping soils on broad divides and of moderately sloping to moderately steep soils on narrow ridgetops and hillsides adjacent to drainageways on uplands (fig. 3). It is dissected by many small drainageways. Soils in this association formed in loess, are deep, and generally are well drained.

The areal extent of this association is about 208,740 acres, or about 57 percent of Cuming County. Moody soils make up about 41 percent of the association, Nora soils about 24 percent, and Belfore soils 14 percent. The remaining 21 percent consists of minor soils.

Moody soils are on broad divides and hillsides that parallel the drainageways. They are gently sloping to moderately sloping. The surface layer is firm silty clay loam that ranges from 6 to 15 inches in thickness. The subsoil is firm silty clay loam. The upper part of the calcareous underlying material is silty clay loam, and the lower part is silt loam that has brown, yellowish-brown, grayish-brown, and gray mottles.

Nora soils are on narrow ridgetops and on hillsides that border drainageways on uplands. They are moderately sloping to moderately steep, friable soils. The surface layer is silty clay loam that ranges from 5 to 15 inches in thickness. The subsoil is silty clay loam; it is noncalcareous in the upper part and calcareous in the lower part. The underlying material is calcareous silt loam. Brown, yellowish-brown, and reddish-brown mottles occur below the surface layer.

Belfore soils are on broad divides and are nearly

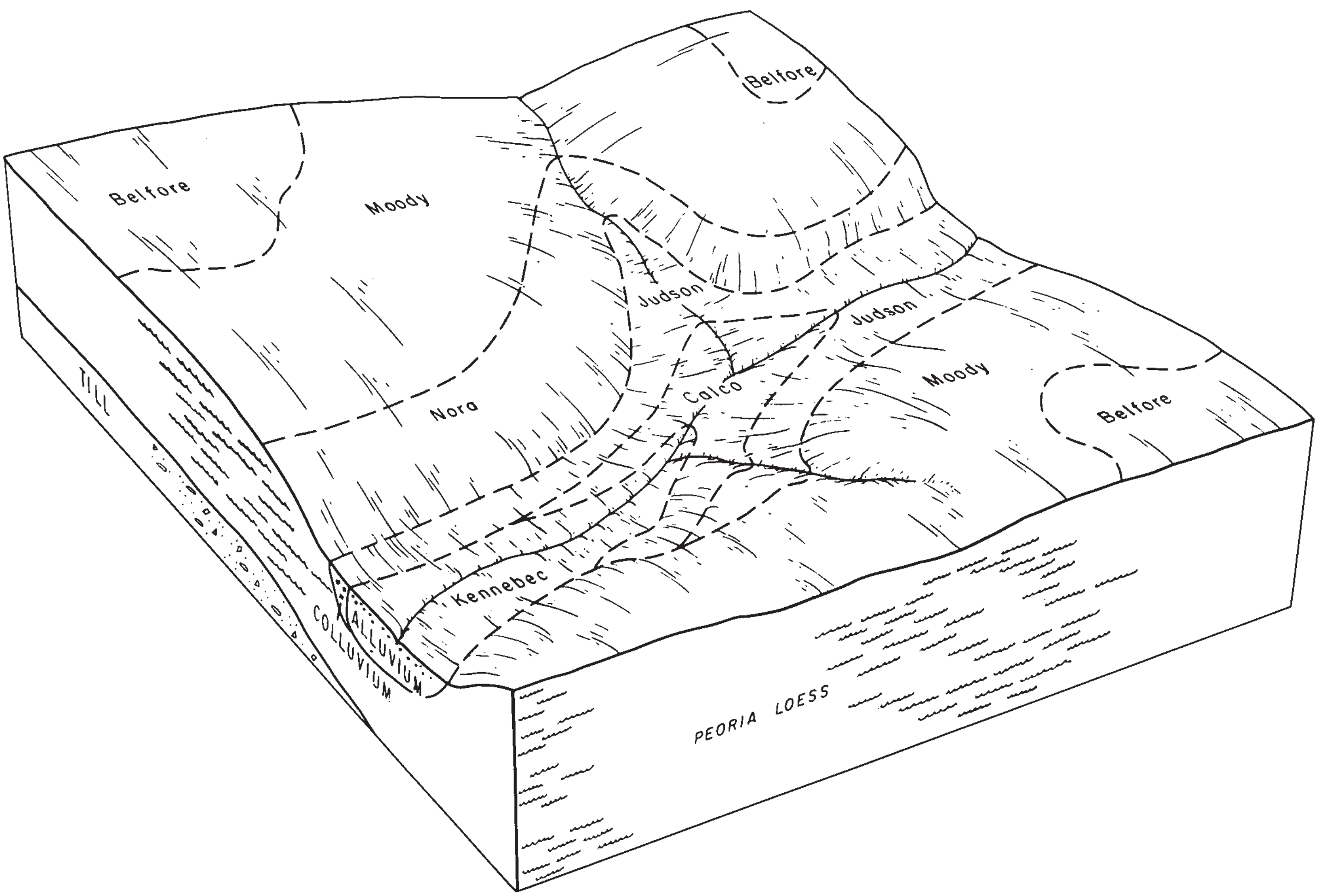

***Figure 3.*—Soils of the Moody-Nora-Belfore association and their relationship to the parent material.**

level. The surface layer is friable silty clay loam that ranges from 10 to 19 inches in thickness. The upper part of the subsoil is firm silty clay, and the lower part is friable silty clay loam. The friable underlying material ranges from silty clay loam to silt loam. Light gray, yellowish-brown, and reddish-brown mottles occur in the lower part of the subsoil and in the underlying material.

The minor soils in this association are the terrace phase of the Belfore series and soils in the Calco, Crofton, Judson, and Kennebec series. The terrace phase of the Belfore series is a nearly level soil that is on narrow stream terraces in a few of the wider valleys. Calco soils are nearly level and somewhat poorly drained; they are in low areas on narrow bottom lands along the upper reaches of upland drainageways and streams. Crofton soils are moderately sloping to steep and are on convex ridges and hillsides that border drainageways. Judson soils are gently sloping and are on foot slopes along narrow drainageways and small stream valleys. Kennebec soils are nearly level and moderately well drained; they are on the highest areas of the narrow bottom lands.

Most of the acreage is cultivated, and the principal crops are corn, soybeans, alfalfa, and oats. Some areas are in pasture, which is grazed by cattle and sheep. In places row crops are irrigated with water from wells.

Farms in this association average about 280 acres in size and are diversified. They are primarily a combination of the cash-grain and livestock types. Soybeans are grown for cash. Much of the grain and hay is fed to cattle and hogs that are being fattened for market. Most of the other farm produce is marketed locally. Fattened cattle and hogs commonly are marketed locally through sale barns and direct livestock buyers, but a small percentage of livestock is shipped to terminal markets in large cities outside the county. The markets are readily accessible. Gravel, blacktop, or improved dirt roads are on most section lines. Concrete or blacktop State and Federal highways cross the area.

Controlling erosion, conserving water, and maintaining fertility are the chief concerns of management in this association. Localized flooding is a hazard, and wetness limits the use of some soils.

4. *Zook-Leshara-Wann association*

Deep, somewhat poorly drained, nearly level, clayey, silty, and loamy soils on bottom lands

This association consists mostly of nearly level soils on the flood plain in the Elkhorn River valley (fig. 4). These soils formed in sandy, loamy, and clayey alluvium. They are deep and generally are somewhat poorly drained. Before the Elkhorn River was straight-

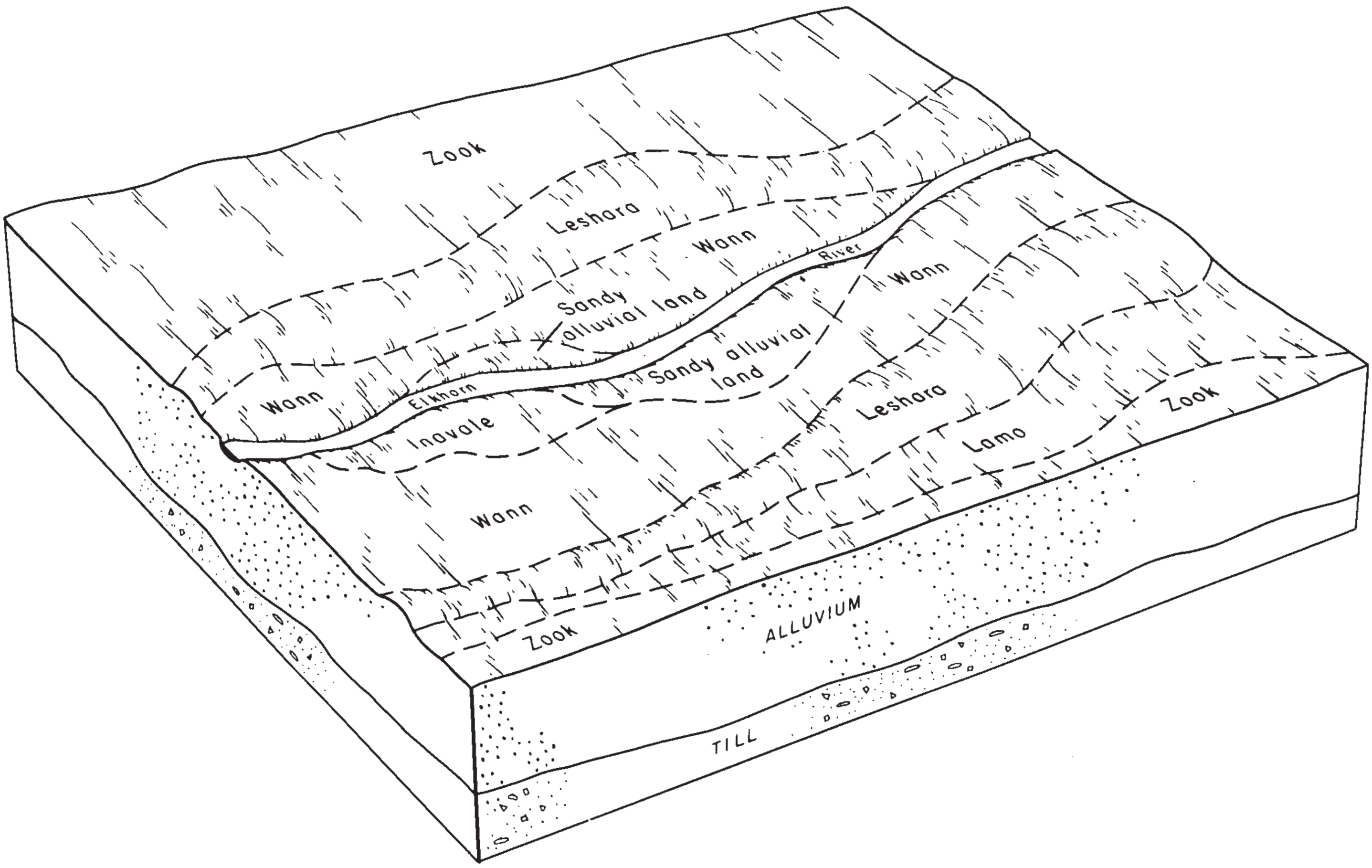

***Figure 4.*—Soils of the Zook-Leshara-Wann association and their relationship to the topography and underlying material.**

ened, its course through this association was very meandering.

The areal extent of this association is about 26,000 acres, or about 7 percent of Cuming County. Zook soils make up about 26 percent of the association, Leshara soils 18 percent, and Wann soils 17 percent. The remaining 39 percent consists of minor soils and land types.

Zook soils are on some of the lowest areas of bottom land. They have a firm silty clay loam and silty clay surface layer that ranges from 24 to 34 inches in thickness. The subsoil and underlying material are firm to very firm silty clay. Faint reddish-brown mottles occur in the underlying material.

Leshara soils are on the intermediate elevations of bottom lands. These soils have a friable silt loam surface layer that ranges from 10 to 22 inches in thickness. Beneath this is a transitional layer of calcareous silt loam. The calcareous underlying material is silt loam in the upper part and sandy loam in the lower part. Yellowish-brown mottles occur below the surface layer.

Wann soils are in low areas adjacent to streams or their former channels. They have a very friable surface layer that ranges from 12 to 20 inches in thickness. The calcareous underlying material ranges from very friable fine sandy loam to sandy loam to a depth of about 40 inches and from loose very fine sandy loam to fine sand below that depth. Faint yellowish-brown mottles occur in the underlying material.

The minor soils in this association consist of soils in the Inavale and Lamo series and of areas of Sandy alluvial land. Inavale soils are in the highest areas of bottom lands, are nearly level to gently sloping, and are excessively drained. Lamo soils are in the lowest areas of bottom lands, are nearly level, and are somewhat poorly drained. Sandy alluvial land is nearly level and consists of mixed sand and silty alluvial material on low areas of the flood plain, where flooding occurs several times each year.

About 60 percent of the acreage is cultivated. Corn, soybeans, and alfalfa are the principal crops. The remaining areas are generally in pasture grasses, hay, and native woodland. The native woodland usually is used for pasture by livestock. A few areas in this association are irrigated either by gravity method or by sprinkler systems, with water pumped from wells or from the Elkhorn River.

Farms in this association average about 240 acres in size and are diversified. They are of the cash-grain type or a combination of the cash-grain and livestock types. Cattle and hogs are fattened in feedlots. Nearly all the grain and hay produced are fed to livestock. Most cash crops and livestock are marketed locally, but some livestock is shipped to terminal markets in large cities outside the county. The markets are readily accessible. Only a few roads are on section lines, but several gravel roads and one paved highway cross the area.

Flooding and wetness related to a high water table are the principal limitations of the soils in this association. Maintaining high fertility and organic-matter content are the main concerns of management.

5. *Thurman-Leisy-Moody association*

Deep, somewhat excessively drained and well-drained, nearly level to moderately sloping, sandy, loamy, and silty soils on uplands

This association consists mostly of gently sloping to moderately sloping soils on rounded divides and of nearly level to gently sloping soils on the sides and bottoms of swales (fig. 5). These are deep soils that formed mostly in eolian sand and loess.

The areal extent of this association is about 35,000 acres, or 10 percent of Cuming County. Thurman soils make up about 30 percent of the association, Leisy soils 23 percent, and Moody soils 20 percent. The remaining 27 percent consists of minor soils.

Thurman soils are on rounded upland divides. They are nearly level to moderately sloping, somewhat excessively drained soils that formed in eolian sand. The surface layer is very friable loamy fine sand and ranges from 10 to 19 inches in thickness. Beneath this is a transitional layer of very friable loamy fine sand. The underlying material is loose fine sand.

Leisy soils are on side slopes and in swales at slightly lower elevations than Thurman soils. They are well-drained, gently sloping to moderately sloping soils that formed in eolian fine sand. The surface layer, which ranges from 10 to 20 inches in thickness, is very friable fine sandy loam and loam. The subsoil is very friable loam in the upper part and firm silty clay loam in the lower part. The underlying material, which is generally below a depth of 60 inches, ranges from friable silty clay loam to loam. Reddish-brown mottles occur in the lower part of the subsoil.

Moody soils are in swales and on hillsides adjacent to upland drainageways. They are well-drained, gently sloping to moderately sloping soils that formed in loess. The surface layer, which ranges from 6 to 15 inches in thickness, and the subsoil are firm silty clay loam. The upper part of the calcareous underlying material is firm silty clay loam, and the lower part is friable silt loam that has brown, yellowish-brown, grayish-brown, and gray mottles.

The minor soils in this association are in the Valentine, Cass, and Judson series. Valentine soils occupy high positions on the landscape, are gently sloping to moderately sloping, and are excessively drained. Cass soils are on bottom lands of narrow streams and drainageways and are nearly level and well drained. Judson soils are on colluvial foot slopes that border upland drainageways and small stream valleys; they are gently sloping and well drained.

About 80 percent of the acreage is cultivated, about 15 percent is in pasture, and 5 percent is in native grass. Corn, soybeans, alfalfa, and grain sorghum are the principal crops. The steeper sandy soils are used mainly for pasture and range. A few areas that are used for crops are irrigated with sprinkler systems.

Farms in this association average about 260 acres in size and are diversified. They are mainly a combination of the cash-grain and livestock types. Many cattle and hogs are fattened in feedlots, and these livestock generally are marketed locally. Most of the sheep and milk produced are shipped by truck to markets outside the county. Gravel or improved dirt roads are

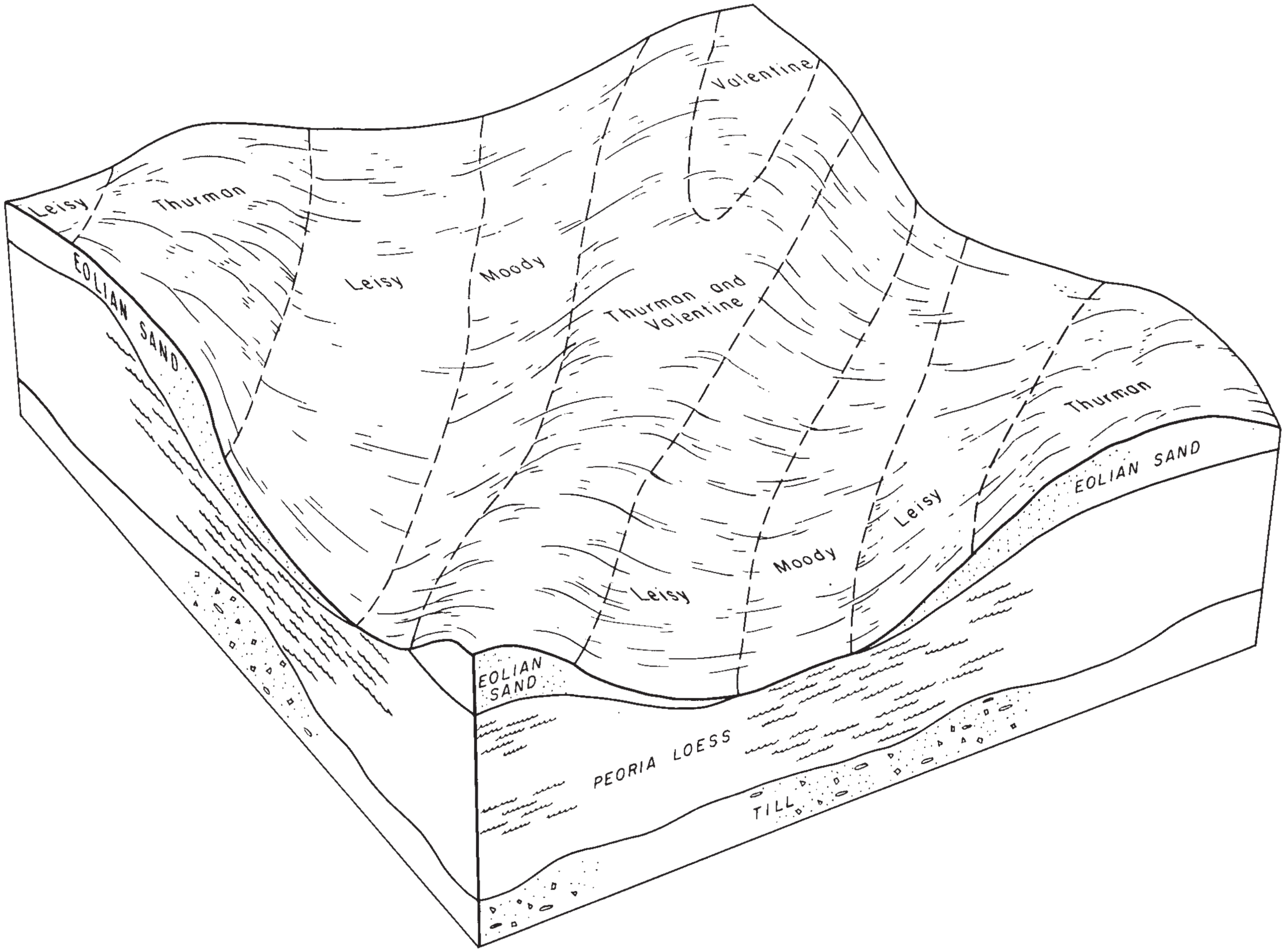

***Figure 5.*—Soils of the Thurman-Leisy-Moody association and their relationship to parent material.**

on most section lines, and a few blacktop highways cross the area.

Soil blowing, water erosion, and a lack of adequate rainfall are the principal limitations where the soils in this association are cultivated. Improving fertility and organic-matter content are important concerns of management. Use of the proper grazing system is an important concern where the soils are in pasture.

Descriptions of the Soils

This section describes the soil series and mapping units in Cuming County. Each soil series is described in detail, and then each mapping unit in that series is described briefly. Unless specifically indicated otherwise, statements about the soil series should be assumed to hold true for all mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which the unit belongs.

An important part of the description of each soil series is the soil profile—that is, the sequence of layers from the surface downward to a depth of 60 inches. For each profile, there are two descriptions. The first is brief and in terms familiar to the layman. The second, more detailed and in technical terms, is for those who need to make thorough and precise studies of the soils.

The profile described generally is representative for mapping units in the series. If the profile of a given mapping unit differs from the one described for the series, the differences are stated in the description of the mapping unit or are apparent in the name of the mapping unit. Unless it is otherwise noted, the colors given in the descriptions are those of a dry soil and the terms for consistence are those of a moist soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Sandy alluvial land, for example, does not belong to a soil series but, nevertheless, is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and windbreak suitability group in which the mapping unit has been placed. The page for the description of each capability unit and windbreak suitability group is given in the "Guide to Mapping Units" at the back of this survey.

Many of the terms used in describing soils can be found in the "Glossary," which immediately precedes the "Guide to Mapping Units." Detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*4*).

The acreage and proportionate extent of each mapping unit are shown in table 1.

Names, descriptions, and boundaries of soils do not agree fully with those in recently published surveys of adjacent counties. Such differences result from a better knowledge of the soils, modifications in the concept of the soil series, and changes in the intensity of mapping.

Belfore Series

The Belfore series consists of deep, nearly level, well-drained soils that formed in loess. These soils are on broad ridgetops on uplands and on narrow stream terraces in a few of the wider valleys.

In a representative profile, the surface layer is about 14 inches thick and consists of dark grayish-brown, friable silty clay loam. The subsoil is about 34 inches thick. The upper 11 inches is grayish-brown and brown, firm silty clay; the middle part is pale-brown, firm silty clay loam; and the lower 9 inches is light olive-brown, friable silty clay loam. The underlying material, below a depth of 48 inches, is light yellowish-brown silty clay loam. Yellowish-brown and light-gray mottles occur below a depth of 25 inches.

Belfore soils have moderately slow permeability, high available water capacity, and high organic-matter content. They release moisture readily to plants. Reaction is medium acid in the surface layer and is medium acid to slightly acid throughout the rest of the profile.

These soils are well suited to the locally grown cultivated crops. They also are suited to grass, trees, and shrubs, and they provide habitat for wildlife.

Representative profile of Belfore silty clay loam, 0 to 2 percent slopes, in a cultivated field, 1,056 feet east and 100 feet north of the southwest corner of sec. 17, T. 23 N., R. 7 E.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate, fine and very fine, granular structure; soft, friable; medium acid; abrupt, smooth boundary.

A12—7 to 14 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate, medium, subangular blocky structure parting to moderate, fine and medium, granular; soft, friable; medium acid; clear, smooth boundary.

B21t—14 to 19 inches, grayish-brown (10YR 5/2) light silty clay, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to moderate, medium and coarse, subangular blocky; hard, firm; medium acid; clear, smooth boundary.

B22t—19 to 25 inches, brown (10YR 5/3) light silty clay, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; thin continuous coating on face of peds; slightly acid; clear, smooth boundary.

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

Soil	Acres	Percent	Soil	Acres	Percent
Belfore silty clay loam, 0 to 2 percent slopes	30,700	8.4	Moody silty clay loam, 2 to 6 percent slopes	63,271	17.3
Belfore silty clay loam, terrace, 0 to 2 percent slopes	2,300	.6	Moody silty clay loam, 2 to 6 percent slopes, eroded	5,600	1.5
Boel loam, 0 to 2 percent slopes	2,100	.6	Moody silty clay loam, 6 to 11 percent slopes	19,300	5.3
Calco silty clay loam, 0 to 2 percent slopes	10,100	2.8	Moody silty clay loam, 6 to 11 percent slopes, eroded	22,000	6.0
Calco silty clay loam, wet, 0 to 2 percent slopes	1,500	.4	Nora silty clay loam, 6 to 11 percent slopes	11,400	3.1
Cass fine sandy loam, 0 to 2 percent slopes	1,450	.4	Nora silty clay loam, 6 to 11 percent slopes, eroded	57,500	15.7
Colo silty clay loam, 0 to 2 percent slopes	14,000	3.8	Nora silty clay loam, 11 to 15 percent slopes	3,750	1.0
Crofton silt loam, 6 to 11 percent slopes, eroded	3,950	1.1	Nora silty clay loam, 11 to 15 percent slopes, eroded	13,900	3.8
Crofton silt loam, 11 to 15 percent slopes, eroded	2,900	.8	Sandy alluvial land	1,400	.4
Crofton silt loam, 15 to 30 percent slopes	1,700	.5	Silty alluvial land	1,250	.3
Inavale loamy fine sand, 0 to 2 percent slopes	1,300	.4	Thurman and Valentine loamy fine sands, 0 to 3 percent slopes	750	.2
Inavale loamy fine sand, 2 to 6 percent slopes	425	.1	Thurman and Valentine loamy fine sands, 3 to 6 percent slopes	10,400	2.8
Judson silty clay loam, 2 to 6 percent slopes	32,000	8.8	Thurman and Valentine loamy fine sands, 6 to 11 percent slopes	1,400	.4
Kennebec silt loam, 0 to 2 percent slopes	5,800	1.6	Valentine loamy fine sand, 3 to 10 percent slopes	910	.3
Kennebec silt loam, overwash, 0 to 2 percent slopes	4,750	1.3	Wann loam, 0 to 2 percent slopes	4,800	1.3
Lamo silty clay loam, 0 to 2 percent slopes	1,750	.5	Zook silty clay loam, 0 to 2 percent slopes	10,600	2.9
Lamo silty clay loam, wet, 0 to 1 percent slopes	1,050	.3	Zook silty clay, 0 to 2 percent slopes	2,600	.7
Lamo-Slickspots complex, 0 to 2 percent slopes	800	.2	Water (areas less than 40 acres)	2,000	.6
Leisy fine sandy loam, 2 to 6 percent slopes	6,600	1.7	Gravel pits	372	.1
Leisy fine sandy loam, 6 to 9 percent slopes	327	.1			
Leisy loam, 2 to 6 percent slopes	1,300	.4			
Leshara silt loam, 0 to 2 percent slopes	5,100	1.4			
Marsh	335	.1	Total	365,440	100.0

B23—25 to 39 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; few, fine, faint, yellowish-brown (10YR 5/6) moist and light-gray (10YR 7/2) moist mottles; moderate, coarse, prismatic structure parting to moderate, fine and medium, subangular blocky; hard, firm; thin continuous coating on faces of peds; medium acid; clear, smooth boundary.

B3—39 to 48 inches, light olive-brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) moist; few, fine, faint, yellowish-brown (10YR 5/6) moist and light-gray (10YR 7/2) moist mottles; weak, coarse, prismatic structure parting to moderate, coarse, subangular blocky; slightly hard, friable; slightly acid; clear, smooth boundary.

C1—48 to 55 inches, light yellowish-brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) moist; few, medium, prominent, yellowish-brown (10YR 5/6) moist and light-gray (10YR 7/2) moist mottles; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable; slightly acid; gradual, wavy boundary.

C2—55 to 60 inches, light yellowish-brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) moist; few, medium, prominent, yellowish-brown (10YR 5/6) moist and light-gray (10YR 7/2) moist mottles; massive; slightly hard, friable; slightly acid.

The A horizon ranges from 10 to 19 inches in thickness, from very dark gray to dark grayish brown in color, and from neutral to medium acid in reaction. The B2t horizon ranges from 8 to 18 inches in thickness and is grayish brown, light olive brown, or brown. Light-gray and yellowish-brown to reddish-brown mottles are common in the lower part of the B horizon and in the C horizon. The C horizon ranges from silty clay loam to silt loam and is calcareous below a depth of 50 inches.

On the landscape, Belfore soils are associated with Moody and Nora soils. They have a finer textured, more strongly developed B horizon and are more deeply leached of lime than Moody or Nora soils.

Belfore silty clay loam, 0 to 2 percent slopes (Be).—This soil is on upland divides. It formed in loess and is in areas that range from 10 to 100 acres in size. Its profile is the one described as representative of the Belfore series.

Included with this soil in mapping were some small depressional areas where the soils have a thicker surface layer and a lighter colored subsoil than Belfore soils. Also included were small areas of Moody soils.

Runoff is slow, and the hazard of erosion is slight. If this soil is tilled when wet, the plow layer becomes cloddy and hard upon drying and the layer immediately beneath is compacted. Otherwise, the surface layer has good workability. Maintaining good tilth and a high level of fertility are important concerns of management.

Much of this Belfore silty clay loam is planted to corn, soybeans, alfalfa, oats, and grain and forage sorghum. This soil is also suited to hay, pasture, and trees for windbreaks. It provides habitat for wildlife and areas for recreation. (Capability unit I–1; windbreak suitability group 4)

Belfore silty clay loam, terrace, 0 to 2 percent slopes (Bf).—This soil is on narrow stream terraces in the wider valleys of the main creeks and rivers; it is in areas that range from 10 to 50 acres in size. Its profile is similar to the one described as representative of the Belfore series, but the surface layer is thicker and the average depth to lime is slightly less.

Included with this soil in mapping were small areas of Moody and Judson soils and of alkali slickspots.

Runoff is slow, and the hazard of erosion is slight. If this soil is tilled when wet, the plow layer becomes cloddy and hard upon drying and the layer immediately beneath is compacted. Otherwise, the surface layer has good workability. Improving tilth and maintaining a high level of fertility are important concerns of management.

This Belfore silty clay loam is used mostly for cultivated crops, the most important of which are corn, soybeans, and alfalfa. Small areas are used for pasture and windbreaks, which provide habitat for wildlife. (Capability unit I–1; windbreak suitability group 1)

Boel Series

The Boel series consists of deep, nearly level, somewhat poorly drained soils that formed in loamy and sandy alluvium on bottom lands. The water table is at a depth of 2 to 6 feet.

In a representative profile, the surface layer is dark-gray, friable loam about 9 inches thick. Beneath this is a transitional layer of gray friable loam that is 3 inches thick. The upper part of the underlying material is light-gray fine sand that has reddish-brown mottles. Below a depth of 40 inches, the underlying material consists of stratified layers of gray silt loam and light brownish-gray and light-gray fine sand and has brown and reddish-brown mottles.

Boel soils have rapid permeability, moderate available water capacity, and moderate organic-matter content. They release moisture readily to plants. Reaction is generally mildly alkaline except in the uppermost and bottommost layers of the underlying material, where it is neutral.

These soils are suited to cultivated crops, grass, and trees. They also provide habitat for wildlife and areas for recreation.

Representative profile of Boel loam, 0 to 2 percent slopes, in a cultivated field, 1,056 feet west and 264 feet south of the northeast corner of SE1/4 sec. 11, T. 23 N., R. 4 E.:

Ap—0 to 9 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; weak, fine, subangular blocky structure parting to weak, fine, granular; slightly hard, friable; mildly alkaline; abrupt, smooth boundary.

AC—9 to 12 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard, friable; mildly alkaline; abrupt, smooth boundary.

IIC1—12 to 40 inches, light-gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; few, fine, distinct, reddish-brown (5YR 5/4) moist mottles; single grained; loose; neutral; abrupt, smooth boundary.

IIC2—40 to 44 inches, gray (10YR 5/1) silt loam, dark gray (10YR 4/1) moist; weak, fine, platy structure; many, fine, distinct, brown (7.5YR 5/4) moist mottles; soft, very friable; mildly alkaline; abrupt, smooth boundary.

IIC3—44 to 48 inches, light brownish-gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; few, fine, prominent, brown (7.5YR 5/4) moist mottles; single grained; loose; mildly alkaline; abrupt, smooth boundary.

IIC4—48 to 54 inches, gray (10YR 5/1) silt loam, dark gray (10YR 4/1) moist; many, medium, prominent, reddish-brown (5YR 4/4) moist mottles;

massive; soft, very friable; mildly alkaline; abrupt, smooth boundary.

IIC5—54 to 60 inches, light-gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; small, reddish-brown (5YR 4/4) moist mottles; single grained; loose; neutral.

The A horizon is loam or silt loam. It ranges from dark gray to black and from 10 to 19 inches in thickness. The AC horizon is loam or fine sandy loam and ranges from gray to very dark grayish brown. The IIC horizon is fine sand or loamy fine sand and ranges from grayish brown to light gray. In places, the IIC horizon has thin lenses of dark colored silt loam or fine sandy loam.

On the landscape, Boel soils are associated with Inavale, Wann, and Leshara soils. They have a higher water table and are less well drained than Inavale soils, and they are coarser textured in the upper part of the C horizon than Wann or Leshara soils.

Boel loam, 0 to 2 percent slopes (Bo).—This soil is adjacent to former channels of the Elkhorn River and generally is dissected by many shallow channels. It is in areas that range from 5 to 25 acres in size.

Included with this soil in mapping were small areas of Inavale and Wann soils. Also included were small sandy areas and some wet areas.

Runoff is very slow. Wetness related to poor drainage and to a moderately high water table can be a limitation in spring. Where the surface layer is dry and unprotected, soil blowing is a hazard. Boel loam is deficient in the plant nutrients needed for some row crops.

Most of the acreage of this soil is in native grass and trees. Only a few areas have been cleared of trees and are cultivated. (Capability unit IIIw–4; windbreak suitability group 2)

Calco Series

The Calco series consists of deep, nearly level, somewhat poorly drained soils. These soils formed in silty alluvium on bottom lands along drainageways on uplands. They are subject to occasional flooding. The water table is within a depth of 6 feet.

In a representative profile (fig. 6), the surface layer is dark-gray, firm silty clay loam about 48 inches thick. The subsoil is gray, firm silty clay loam, and the underlying material, which is below a depth of 56 inches, is dark-gray silty clay loam. Yellowish-brown and reddish-brown mottles and small concretions are below a depth of 35 inches.

Calco soils have moderately slow permeability, high available water capacity, and high organic-matter content. They release moisture readily to plants. Reaction is moderately alkaline except in the lower part of the surface layer, which is strongly alkaline.

These soils are suited to grass for grazing, for use as hayland, and for planting trees and shrubs. Except where wetness related to the high water table is a limitation, they are suited to cultivated crops. They also provide habitat for wildlife and areas for recreation.

Representative profile of Calco silty clay loam, 0 to 2 percent slopes, in a pasture, 850 feet west and 400 feet south of the northeast corner of sec. 34, T. 22 N., R. 7 E.:

A11—0 to 9 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak, medium, granular

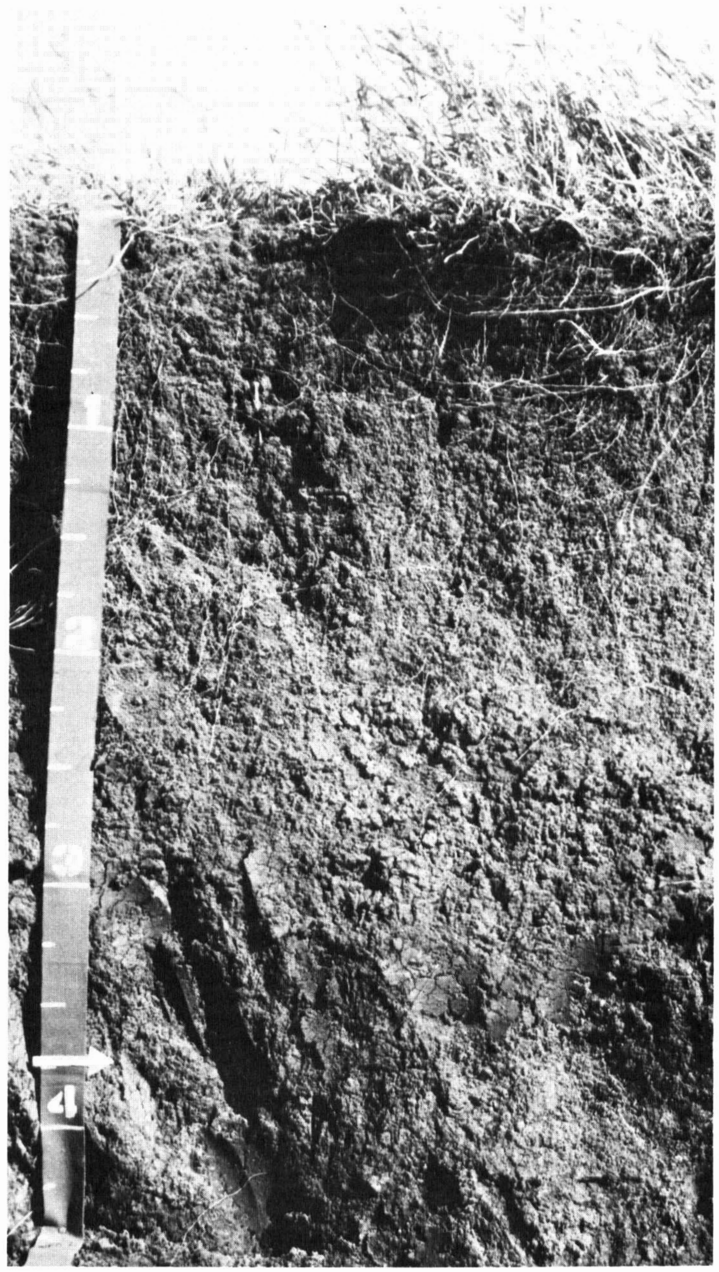

Figure 6.—**A representative profile of a Calco silty clay loam.**

structure; hard, firm; strong effervescence; moderately alkaline; gradual, smooth boundary.

A12—9 to 35 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak, medium, subangular blocky structure parting to weak, medium, granular; hard, firm; violent effervescence; strongly alkaline; gradual, smooth boundary.

A13—35 to 48 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; few, fine, faint, yellowish-brown (10YR 5/6) moist and reddish-brown (5YR 4/4) moist mottles; moderate, medium, subangular blocky structure parting to moderate, medium, granular; hard, firm; common, small concretions; violent effervescence; strongly alkaline; gradual, smooth boundary.

Bg—48 to 56 inches, gray (10YR 5/1) silty clay loam; very dark gray (N 3/) moist; few, fine, faint, yellowish-brown (10YR 5/6) moist and reddish-brown (5YR 4/4) moist mottles; moderate, medium, coarse, subangular blocky structure parting to weak, fine, subangular blocky; hard, firm; common, small concretions; violent effervescence; moderately alkaline; gradual, smooth boundary.

Cg—56 to 60 inches, dark-gray (10YR 4/1) silty clay loam, black (N 2/) moist; few, fine, faint, reddish-brown (5YR 4/4) moist mottles; moderate, coarse, subangular blocky structure; hard, firm; common, small concretions; moderately alkaline.

The A horizon ranges from 30 to 48 inches in thickness and from dark gray to very dark grayish brown in color. It consists of heavy silt loam or silty clay loam. Depth to lime ranges from less than 1 inch to 12 inches below the surface. The B horizon is gray or very dark gray. The C horizon ranges from gray to black and from silt loam to light silty clay. Yellowish-brown, reddish-brown, and brown mottles are in the B horizon and, in some profiles, in the lower part of the A horizon. A few reddish-brown and yellowish-brown mottles are in the C horizon.

On the landscape, Calco soils are associated with Colo and Zook soils. They are similar to the Colo soils in color and texture but have more lime in the profile; they are similar to the Zook soils in texture of the A horizon but have coarser textured underlying material.

Calco silty clay loam, 0 to 2 percent slopes (Ca).—This soil is on bottom lands along streams and major drainageways on uplands. It is in moderately large areas that range from 25 to 100 acres in size. The profile of this soil is the one described as representative of the Calco series.

Included with this soil in mapping were small areas of Colo, Zook, and Leshara soils. Also included were small areas where the soil is noncalcareous to a depth of 20 inches, small areas that have a thin deposit of silt loam on the surface, and a few wet spots that range in size from ½ acre to 3 acres.

Runoff is slow. The water table is within a depth of 2 to 6 feet and is highest in the spring. This Calco silty clay loam is subject to occasional flooding. Wetness tends to delay tillage operations early in spring and is the principal limitation.

About 60 percent of the acreage of this soil is cultivated. Corn, soybeans, alfalfa, and grain sorghum are the principal crops. Several poorly drained areas along creeks are used for pasture and hay. A few small areas that are neither cultivated nor in pasture provide good habitat for wildlife. (Capability unit IIw–4; windbreak suitability group 2)

Calco silty clay loam, wet, 0 to 2 percent slopes (Cb).—This soil is on narrow bottom lands along the upper part of drainageways and creeks on uplands. It is in areas that range from 5 to 20 acres in size. The profile of this soil is similar to the one described as representative of the Calco series, but the water table is at a depth of 0 to 3 feet and more numerous, larger mottles occur in the surface layer. Included with this soil in mapping were small areas of Calco silty clay loam and Marsh.

Runoff is very slow. Wetness related to the high water table and flooding is the principal limitation of this wet Calco silty clay loam.

This soil is too wet to be cultivated for crops commonly grown in the county. It is used for pasture and hay, and it provides habitat for wildlife. (Capability unit Vw–7; windbreak suitability group 6)

Cass Series

The Cass series consists of deep, nearly level, well-drained soils that formed in alluvium on bottom lands in the Elkhorn River valley. Depth to the water table in these soils is generally between 6 and 10 feet.

In a representative profile, the surface layer is very friable fine sandy loam that is dark grayish brown in the upper 9 inches and dark gray in the remaining 11 inches. Beneath this layer is a transitional layer of dark-brown, very friable sandy loam about 18 inches thick. The underlying material, which is below a depth of 38 inches, is brown loamy fine sand in the upper part, dark yellowish-brown very fine sandy loam in the middle part, and pale-brown fine sand in the lower part.

Cass soils have moderately rapid permeability. They have moderate available water capacity and organic-matter content and medium natural fertility.

These soils are suited to cultivated crops, hay, pasture, and trees for windbreaks. They also provide habitat for wildlife and areas for recreation.

Representative profile of Cass fine sandy loam, 0 to 2 percent slopes, 150 feet north and 150 feet east of the southwest corner of sec. 15, T. 23 N., R. 4 E.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

A12—9 to 20 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak, medium and fine, subangular blocky structure, parting to weak, fine, granular; slightly hard, very friable; slightly acid; clear, wavy boundary.

AC—20 to 38 inches, dark-brown (10YR 4/3) sandy loam, dark yellowish brown (10YR 3/4) moist; weak, fine, subangular blocky structure parting to weak, fine, granular; slightly hard, very friable; slightly acid; clear, wavy boundary.

C1—38 to 48 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; soft, very friable; neutral; clear, wavy boundary.

C2—48 to 54 inches, dark yellowish-brown (10YR 4/4) very fine sandy loam, dark yellowish brown (10YR 3/4) moist; weak, medium, subangular blocky structure; slightly hard, very friable; few brown iron stains; neutral; clear, wavy boundary.

C3—54 to 60 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; few brown iron stains; neutral.

The solum ranges from 13 to 20 inches in thickness. The A horizon is dominantly fine sandy loam but ranges to loam in texture. It is dark gray or dark grayish brown in color and neutral to slightly acid in reaction. The AC horizon ranges from 6 to 18 inches in thickness. It is fine sandy loam or sandy loam and is dark brown or dark yellowish brown. The C horizon is loamy fine sand, fine sandy loam, sandy loam, or fine sand and commonly has lenses of very fine sandy loam. It is mixed dark brown and yellowish brown or brown and pale brown.

On the landscape, Cass soils are associated with Lamo, Leshara, and Inavale soils. They are coarser textured throughout the profile than Lamo or Leshara soils and are not flooded so frequently; they are finer textured, are darker colored, and have a thicker A horizon than Inavale soils.

Cass fine sandy loam, 0 to 2 percent slopes (Cd).—This soil is in irregularly shaped areas along the Elkhorn River and a few of its small tributaries. Included in mapping were small wet spots and small areas of Leshara, Wann, and Inavale soils.

Runoff is slow. Soil blowing and flooding in spring or early in summer are slight hazards.

Cass fine sandy loam is used mainly for cultivated crops. A few trees are grown for windbreaks. This soil provides habitat for open-land wildlife. (Capability unit IIs–6; windbreak suitability group 3)

Colo Series

The Colo Series consists of deep, nearly level, somewhat poorly drained soils that formed in silty alluvium on bottom lands and low terraces of the major stream valleys. These soils are occasionally flooded. The water table is at a depth of 3 to 8 feet.

In a representative profile, the surface layer is friable silty clay loam that is very dark gray in the upper 21 inches and dark gray in the remaining 13 inches. Beneath this is a transitional layer of gray, firm silty clay loam about 20 inches thick. The underlying material, which is below a depth of 54 inches, is dark-gray silty clay loam.

Colo soils have moderately slow permeability and high available water capacity, organic-matter content, and natural fertility.

These soils are suited to cultivated crops, grass, and trees. They also provide habitat for wildlife.

Representative profile of Colo silty clay loam, 0 to 2 percent slopes, 250 feet south and 150 feet east of the northwest corner of sec. 32, T. 22 N., R. 5 E.:

A11—0 to 8 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak, medium, subangular blocky structure parting to weak, fine, medium, granular; slightly hard, friable; slightly acid; abrupt, smooth boundary.

A12—8 to 21 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak, medium, subangular blocky structure parting to moderate, medium, granular; slightly hard, friable; slightly acid; gradual, wavy boundary.

A13—21 to 34 inches, dark-gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak, medium, prismatic structure parting to moderate, medium, blocky; slightly hard, friable; neutral; gradual, wavy boundary.

AC—34 to 54 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; few, fine, faint, brown (10YR 5/3) moist mottles; weak, medium, prismatic structure parting to moderate, medium, blocky; hard, firm; neutral; gradual, wavy boundary.

Cg—54 to 60 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; few, fine, faint, brown (10YR 5/3) moist mottles; weak, coarse, prismatic structure; hard, firm; neutral.

The A horizon ranges from 22 to 34 inches in thickness and is very dark grayish brown to black when moist. The AC horizon is silty clay loam, is 10 to 20 inches thick, and is very dark gray to black when moist. This horizon has weak, medium, subangular blocky structure or weak, coarse, prismatic. It is slightly acid or neutral. The Cg horizon ranges from silty clay loam to light silty clay and has a few thin strata of silt loam. This horizon is mostly dark gray, but it is very dark gray in places. Reddish-brown, yellowish-brown, or brown mottles are common.

On the landscape, Colo soils are associated with Lamo and Zook soils. These soils are mostly similar in texture, but Colo soils lack the calcium carbonate that is in Lamo soils, and they are coarser textured in the C horizon than Zook soils.

Colo silty clay loam, 0 to 2 percent slopes (Ce).—This soil is on flat or only slightly concave areas between foot slopes and stream channels. The areas are large and irregular, and they generally parallel the course of the major streams. In places small depressions hold water for short periods after rains or floods.

Included with this soil in mapping were small areas of Lamo and Kennebec soils. Also included were a few areas of soils having a surface layer of silt loam that is lighter colored than the one described in the representative profile.

Runoff is slow. Wetness delays tillage early in spring and is the major limitation of this soil.

Most of the acreage of Colo silty clay loam is cultivated. Corn, soybeans, and alfalfa are the principal crops. This soil provides good habitat for openland wildlife. (Capability unit IIw–4; windbreak suitability group 2)

Crofton Series

The Crofton series consists of deep, well-drained, moderately sloping to steep soils that formed in loess on convex ridges and hillsides.

In a representative profile (fig. 7), the surface layer is grayish-brown, friable silt loam about 6 inches thick. The underlying material is silt loam that is brown in the upper part and light yellowish brown in the lower part. This soil is calcareous throughout its profile. Reddish-brown mottles are throughout the underlying material, and lime concretions are at a depth of 6 to 16 inches.

Crofton soils have moderate permeability, high available water capacity, and low organic-matter content. They absorb moisture easily and release it readily to plants. Reaction is moderately alkaline throughout the profile.

These soils are suited to grass and trees. Where the slopes are not more than 15 percent, the soils are suited to cultivated crops. They also provide habitat for wildlife and areas for recreation.

Representative profile of Crofton silt loam, 6 to 11 percent slopes, eroded, in a cultivated field, 1,320 feet east and 225 feet south of the northwest corner of sec. 7, T. 22 N., R. 4 E.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, friable; violent effervescence; moderately alkaline; abrupt, smooth boundary.

C1—6 to 16 inches, brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; few, fine, faint, reddish-brown (5YR 4/4) moist and gray (10YR 5/1) moist mottles; weak, coarse, prismatic structure; slightly hard, friable; many medium lime concretions; violent effervescence; moderately alkaline; gradual, wavy boundary.

C2—16 to 60 inches, light yellowish-brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) moist; common, medium, distinct, reddish-brown (5YR 4/4) moist mottles; weak, coarse, prismatic structure; slightly hard, friable; violent effervescence; moderately alkaline.

The A horizon ranges from 6 to 10 inches in thickness and is grayish brown to dark grayish brown. It is silt loam or light silty clay loam that is calcareous in cultivated areas. Where the Crofton soil is in native grass, the A horizon is noncalcareous in many places and a thin AC horizon, which is from 2 to 5 inches thick, commonly is present. The C

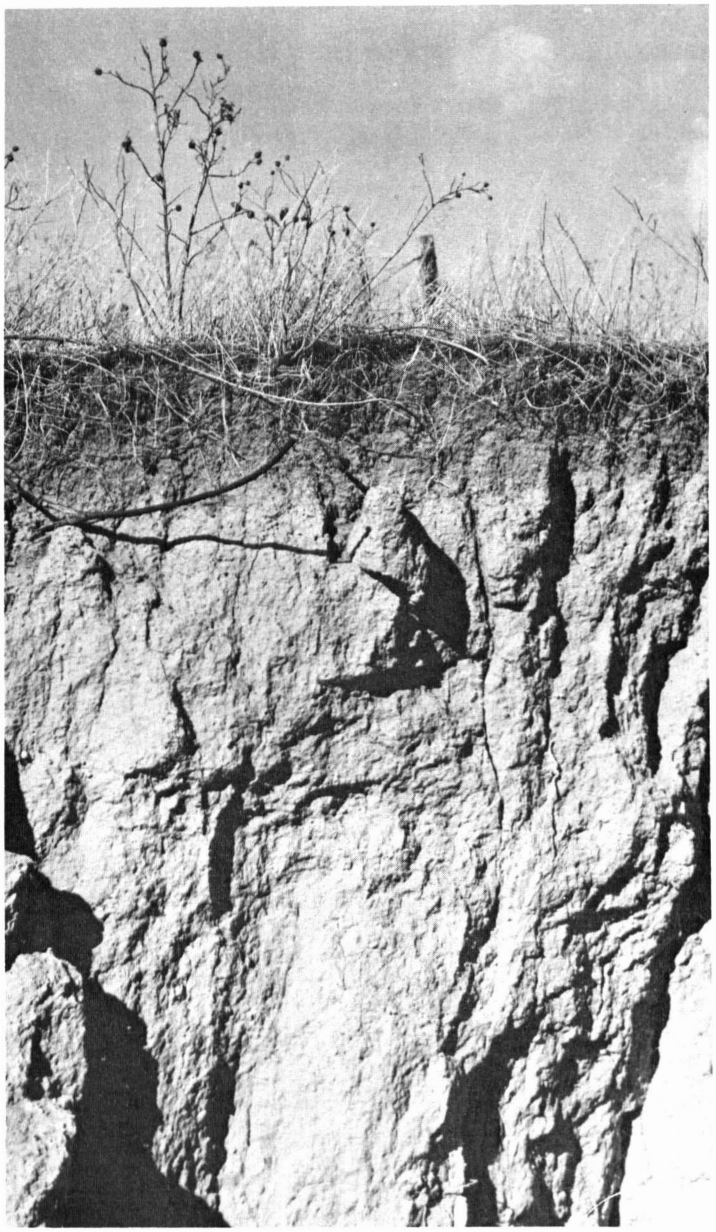

Figure 7.—**A representative profile of a Crofton silt loam, a deep, well-drained soil that has a thin surface layer.**

horizon generally is very pale brown to brown, but in places a band of gray loess crops out in eroded areas.

On the landscape, Crofton soils are associated with Nora and Moody soils. They have a thinner, lighter colored A horizon than Nora and Moody soils; they also have lime nearer the surface, and they contain less clay. Crofton soils lack the B horizon of Nora and Moody soils.

Crofton silt loam, 6 to 11 percent slopes, eroded (CfD2).—This silty soil is on loess uplands in irregular areas that range from 5 to 30 acres in size. Its profile is the one described as representative of the Crofton series. Included in mapping were a few small areas of eroded Moody and Nora soils.

Runoff is rapid. Water erosion and soil blowing are the principal hazards on this Crofton silt loam. Available phosphate and nitrogen are low. Improving and maintaining fertility are concerns of management.

Most of the acreage of this soil is cultivated. Corn and alfalfa are the principal crops. Smaller amounts of soybeans, oats, and grain sorghum are grown. Some areas are planted to introduced grasses and are used for pasture. (Capability unit IVe–9; windbreak suitability group 5)

Crofton silt loam, 11 to 15 percent slopes, eroded (CfE2).—This silty soil is on loess uplands in irregular areas that range from 5 to 20 acres in size. Included in mapping were small areas of eroded Nora soils and a few areas that are not eroded.

Runoff is rapid, and water erosion is the principal hazard on this Crofton silt loam. A lack of sufficient moisture is a limitation. Soil blowing is a hazard if the surface is not adequately protected. Improving and maintaining fertility are concerns of management.

Most of the acreage of this soil is cultivated. Corn, alfalfa, and oats are the principal crops. Smaller amounts of soybeans and grain sorghum are grown. Some areas have been reseeded to tame grass and are used for pasture. In places trees and shrubs have been planted for windbreaks. This soil provides habitat for wildlife and areas for recreation. (Capability unit IVe–9; windbreak suitability group 5)

Crofton silt loam, 15 to 30 percent slopes (CfF).—This silty soil is on loess uplands, mainly on valley sides along the Elkhorn River. It is in small areas that range from 5 to 20 acres in size. The profile of this soil is similar to the one described as representative of the Crofton series, but the surface layer is slightly thicker.

Included with this soil in mapping were small areas of eroded, less steep Crofton soils and of severely eroded Nora soils. Also included were small areas of Thurman soils.

Runoff is very rapid. Where this Crofton silt loam is not protected by vegetative cover, water erosion and soil blowing are major hazards. Plant nutrients, especially nitrogen, commonly are low. Improving and maintaining fertility are concerns of management.

Most of the acreage of this soil is used for pasture, as habitat for wildlife, and for recreation. Small areas are cultivated, but the hazard of water erosion is severe. (Capability unit VIe–9; windbreak suitability group 10)

Inavale Series

The Inavale series consists of deep, excessively drained, nearly level to gently sloping soils. These soils formed in recent sandy alluvium on bottom lands in the Elkhorn River valley.

In a representative profile, the surface layer is dark-gray, very friable loamy fine sand about 5 inches thick. Beneath this, to a depth of 15 inches, is a transitional layer of light brownish-gray loamy fine sand. The underlying material is fine sand that is light gray in the upper part and white in the lower part.

Inavale soils have rapid permeability, low available water capacity, and low organic-matter content. The workability of these soils is only fair because of their loose consistency. They release moisture readily to plants. Reaction is slightly acid except in the underlying material, which is neutral.

Where slope is not more than 2 percent, these soils are suited to cultivated crops, to pasture, and to trees and shrubs for windbreaks. They also provide habitat for wildlife and areas for recreation.

Representative profile of Inavale loamy fine sand. 0 to 2 percent slopes, in a cultivated field, 1,200 feet north and 1,300 feet west of southeast corner of sec. 8, T. 22 N., R. 6 E.:

Ap—0 to 5 inches, dark-gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak, medium and coarse, granular structure; loose, very friable; slightly acid; abrupt, smooth boundary.

AC—5 to 15 inches, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; weak, coarse, granular structure; loose, very friable; slightly acid; clear, wavy boundary.

C1—15 to 30 inches, light-gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; neutral; clear, wavy boundary.

C2—30 to 60 inches, white (10YR 8/2) fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; neutral.

The A horizon ranges from 2 to 6 inches in thickness and from dark gray to grayish brown in color. The AC horizon is 5 to 12 inches thick and is grayish brown or light brownish gray. The C horizon is light gray or white fine sand. In some places layers of finer material, 1 to 3 inches thick, and mottles occur below a depth of 50 inches.

On the landscape, Inavale soils are associated with Wann and Boel soils. They are coarser textured in the upper part of the C horizon than Wann or Boel soils, and they have a thinner A horizon. In addition, the water table is at a lower depth than in Wann or Boel soils.

Inavale loamy fine sand, 0 to 2 percent slopes (In).—This soil is on bottom lands along the Elkhorn River in areas that range from about 3 to 30 acres in size. Its profile is the one described as representative of the Inavale series.

Included with this soil in mapping were areas of soils that have a surface layer of sandy loam, fine sand, or silt loam. These areas make up about 10 percent of the mapping unit. Also included were small areas of soils that have a water table at a depth of 3 to 5 feet.

Runoff is medium. Because the available water capacity is low and the pore spaces in the soil are large, this Inavale loamy fine sand is droughty. Soil blowing is a hazard where the surface is left bare or where the vegetation has been removed.

About one-half of the acreage of this soil is cultivated. Corn, soybeans, oats, and clover are the principal crops. Most of the remaining acreage is used for pasture. Native trees grow in a few areas. (Capability unit IVe–5; windbreak suitability group 3)

Inavale loamy fine sand, 2 to 6 percent slopes (InC).—This soil is on narrow ridges on bottom lands of the Elkhorn River valley. It occurs in areas that range from 2 to 8 acres in size. The profile of this soil is similar to the one described as representative of the Inavale series, but the surface layer is thinner and the underlying material is slightly coarser. Included with this soil in mapping were small areas of more gently sloping Inavale soils and of Wann loam.

Runoff is medium. Inadequate rainfall commonly limits the growth of plants in this soil. A lack of moisture and soil blowing are the principal limitations.

About 10 percent of the acreage of Inavale loamy fine sand is cultivated. The remainder is in range, pasture, and trees. This soil also provides habitat for wildlife and areas for recreation. (Capability unit VIe–5; windbreak suitability group 3)

Judson Series

The Judson series consists of deep, well-drained, gently sloping soils on foot slopes along narrow upland drainageways and small stream valleys. These soils formed in colluvium and alluvium.

In a representative profile, the surface layer is silty clay loam about 33 inches thick. It is friable and very dark grayish brown in the upper part, friable and very dark gray in the middle part, and firm and dark grayish brown in the lower part. The subsoil, to a depth of 60 inches, is firm silty clay loam that is brown in the upper part and yellowish brown in the lower part. A few yellowish-brown mottles occur in the subsoil.

Judson soils have moderate permeability, high available water capacity, and high organic-matter content. They release moisture readily to plants. Reaction is slightly acid throughout the profile.

These soils are suited to all crops commonly grown in the county, to grass, and to trees and shrubs for windbreaks. They also provide habitat for wildlife and areas for recreation.

Representative profile of Judson silty clay loam, 2 to 6 percent slopes, in a cultivated field, 264 feet east and 150 feet south of the northwest corner of NE1/4 sec. 21, T. 23 N., R. 6 E.:

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

A12—10 to 18 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak, fine, subangular blocky structure parting to weak, fine and medium, granular; slightly hard, friable; slightly acid; gradual, smooth boundary.

A13—18 to 26 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak, medium, subangular blocky structure parting to weak, fine and medium, granular; slightly hard, friable; slightly acid; gradual, smooth boundary.

A3—26 to 33 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, subangular blocky structure parting to moderate, medium, granular; hard, firm; slightly acid; gradual, smooth boundary.

B2—33 to 48 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; few, faint, fine, yellowish-brown (10YR 5/6) moist mottles; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; slightly acid; gradual, smooth boundary.

B3—48 to 60 inches, yellowish-brown (10YR 5/4) silty clay loam, brown (10YR 4/3) moist; few, faint, fine, yellowish-brown (10YR 5/6) moist mottles; moderate, medium and coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; slightly acid.

The A horizon ranges from 25 to 36 inches in thickness. The B horizon is silty clay loam or heavy silt loam. It has yellowish-brown or grayish-brown mottles in most places.

On the landscape, Judson soils are associated with Calco, Kennebec, Moody, and Nora soils. They are better drained than Calco soils, have a thinner A horizon than Kennebec soils, and have a thicker A horizon and are more deeply leached of lime than Moody or Nora soils.

Judson silty clay loam, 2 to 6 percent slopes (JuC).—This silty soil is on concave foot slopes in narrow drainageways of the loess uplands. The areas are long and range from about 10 to 100 acres in size. Small, shallow drainageways are common in the higher lying areas.

Included with this soil in mapping were small areas of Moody silty clay loam, 2 to 6 percent slopes. Also included were small areas of gently sloping soils that have a profile similar to that of Kennebec soils.

Runoff is medium. Water erosion is the major hazard. In places, silting after hard rains results in a thin layer of light colored silt loam or silty clay loam on the surface.

Almost all of the acreage of this soil is cultivated. Corn, soybeans, alfalfa, grain sorghum, and oats are the principal crops. A few areas are seeded to cool-season grasses and are used for grazing by livestock. Small areas are in trees or native grass and provide habitat for wildlife. (Capability unit IIe–1; windbreak suitability group 4)

Kennebec Series

The Kennebec series consists of deep, moderately well drained, nearly level soils that formed in silty alluvium on bottom lands.

In a representative profile, the surface layer is friable silt loam that is dark gray in the upper 7 inches and very dark gray in the remaining 19 inches. Beneath this is a transitional layer of dark grayish-brown, friable silt loam about 12 inches thick. The underlying material, below a depth of 38 inches, is dark grayish-brown silt loam in the upper part and very dark gray, light silty clay loam in the lower part. Yellowish-brown and brown mottles are in the underlying material.

Kennebec soils have moderate permeability, high available water capacity, and moderate or high organic-matter content. They release moisture readily to plants. Reaction is slightly acid throughout the profile.

These soils are suited to crops cultivated under dryland or irrigation management. They also are suited to grass and to trees and shrubs for windbreaks, and they provide habitat for wildlife and areas for recreation.

Representative profile of Kennebec silt loam, 0 to 2 percent slopes, in a cultivated field, 264 feet east and 792 feet south of the northwest corner of NE1/4 SW1/4 sec. 10, T. 22 N., R. 6 E.:

Ap—0 to 7 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, fine, granular structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

A12—7 to 12 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak, fine, subangular blocky structure parting to weak, fine, granular; slightly hard, friable; slightly acid; diffuse, smooth boundary.

A13—12 to 26 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak, fine, subangular blocky structure parting to weak, fine and medium, granular; slightly hard, friable; slightly acid; diffuse, smooth boundary.

AC—26 to 38 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure parting to weak, fine and medium, granular; slightly hard, friable; slightly acid; diffuse, smooth boundary.

C1—38 to 47 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; few, faint, fine, yellowish-brown (10YR 5/6) moist mottles; weak, fine, subangular blocky structure parting to moderate, coarse and medium, granular; slightly hard, friable; slightly acid; diffuse, smooth boundary.

C2—47 to 60 inches, very dark gray (10YR 3/1) light silty clay loam, black (10YR 2/1) moist; few, faint, fine, brown (10YR 5/3) moist and yellowish-brown (10YR 5/6) moist mottles; weak, medium, prismatic structure; slightly hard, friable; slightly acid.

The A horizon is 24 to 42 inches thick and is dark grayish brown to very dark gray. The AC horizon ranges from 10 to 24 inches in thickness, from very dark gray to dark grayish brown in color, and from silt loam to light silty clay loam. The C horizon ranges from dark grayish brown to very dark gray and is silt loam or light silty clay loam that has yellowish-brown or brown mottles.

On the landscape Kennebec soils are associated with Colo, Calco, and Judson soils. They are better drained than Colo and Calco soils and they lack lime, which is present in Calco soils. Kennebec soils lack the B horizon that is present in Judson soils, and they have a thicker A horizon than Judson soils.

Kennebec silt loam, 0 to 2 percent slopes (Ke).—This soil is on bottom lands of deeply entrenched drainageways of the loess uplands. It is in long, narrow areas that range from 10 to 70 acres in size. The profile of this soil is the one described as representative of the Kennebec series.

Included with this soil in mapping were small areas of Colo and Judson soils. Also included were small areas that have a dark-brown underlying material.

Runoff is slow. During periods of heavy rainfall, this Kennebec silt loam is flooded by runoff from soils at higher elevations. Flooding, however, is an infrequent hazard in most places. The organic-matter content is high. Maintaining a desirable balance between the fertility and available moisture is the principal concern of management.

Nearly all of the acreage of this soil is cultivated. Corn, soybeans, alfalfa, grain sorghum, and oats are the principal crops. Some areas are in pasture, and in a few areas trees grow in windbreaks. This soil also provides habitat for wildlife and small areas for recreation. (Capability unit I–1; windbreak suitability group 1)

Kennebec silt loam, overwash, 0 to 2 percent slopes (Ko).—This soil is on bottom lands of narrow, shallow drainageways on uplands. It is in irregular areas that range from 4 to about 50 acres in size. The profile of this soil is similar to the one described as representative of the Kennebec series, but it has from 10 to 20 inches of recent silt loam overwash deposited on the original surface layer.

Included with this soil in mapping were small areas of Judson, Colo, and Calco soils. Also included were a few small wet areas.

Runoff is slow. During periods of heavy rainfall, this Kennebec silt loam is flooded by runoff from soils at higher elevations. The flooding commonly delays tillage and planting in spring and is a limitation to use of this soil for crops. The organic-matter content is moderate. Improving tilth and maintaining fertility are concerns of management.

Most of the acreage of this soil is cultivated. Corn, soybeans, alfalfa, and grain sorghum are the principal crops. Areas where flooding is most frequent are commonly in pasture, native grass, and trees. They are used for grazing, and they provide habitat for wildlife. (Capability unit IIw-3; windbreak suitability group 1)

Lamo Series

The Lamo series consists of deep, somewhat poorly drained, nearly level soils that formed in calcareous, silty alluvium on bottom lands. The water table is within a depth of 8 feet.

In a representative profile, the surface layer is very dark gray, firm silty clay loam about 12 inches thick. Beneath this is a transitional layer of dark-gray, firm silty clay loam that is 13 inches thick. The underlying material, which is below a depth of 25 inches, is gray to light-gray silty clay loam in the upper 31 inches and gray very fine sandy loam in the lower part. This soil is calcareous throughout the profile and has yellowish-brown or olive mottles between depths of 39 and 56 inches.

Lamo soils have moderately slow permeability, high available water capacity, and high organic-matter content. They release moisture readily to plants. Reaction is strongly alkaline except in the lower 4 inches of the profile, where it is moderately alkaline.

These soils are suited to cultivated crops, grass, trees, and shrubs. They also provide habitat for wildlife and areas for recreation.

Representative profile of Lamo silty clay loam, 0 to 2 percent slopes, in native grass, 1,320 feet east and 792 feet north of the southwest corner of NW1/4 sec. 35, T. 21 N., R. 6 E.:

Ap—0 to 8 inches, very dark gray (2.5Y 3/0) light silty clay loam, black (2.5Y 2/0) moist; weak, fine, granular structure; slightly hard, firm; violent effervescence; strongly alkaline; clear, smooth boundary.

A12—8 to 12 inches, very dark gray (2.5Y 3/0) silty clay loam, black (2.5Y 2/0) moist; weak, fine, subangular blocky structure parting to weak, fine and medium, granular; slightly hard, firm; violent effervescence; strongly alkaline; clear, smooth boundary.

AC—12 to 25 inches, dark-gray (2.5Y 4/0) silty clay loam, black (2.5Y 2/0) moist; weak, medium, prismatic structure parting to weak, medium, granular; hard, firm; violent effervescence; strongly alkaline; clear, smooth boundary.

C1—25 to 32 inches, gray (2.5Y 5/0) silty clay loam, dark gray (5Y 4/1) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, firm; few, small, lime concretions; violent effervescence; strongly alkaline; clear, smooth boundary.

C2—32 to 39 inches, gray (5Y 6/1) silty clay loam, dark gray (5Y 4/1) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, firm; many, small, lime concretions; violent effervescence; strongly alkaline; clear, smooth boundary.

C3—39 to 48 inches, gray (5Y 6/1) silty clay loam, gray (5Y 5/1) moist; few, faint, yellowish-brown (10YR 5/6) moist mottles; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, firm; violent effervescence; strongly alkaline; clear, smooth boundary.

C4—48 to 56 inches, light-gray (5Y 7/1) silty clay loam, gray (5Y 5/1) moist; massive; many, medium, prominent, olive (5Y 5/6) moist mottles; hard, firm; violent effervescence; strongly alkaline; clear, smooth boundary.

C5—56 to 60 inches, gray (5Y 5/1) very fine sandy loam, dark greenish gray (5GY 4/1) and dark gray (5Y 4/1) moist; massive; slightly hard, friable; violent effervescence; moderately alkaline.

The A horizon ranges from 11 to 22 inches in thickness and is dark gray to black. Some profiles are noncalcareous to a depth of 10 to 14 inches. The AC horizon ranges from 10 to 16 inches in thickness, from dark gray to black, and from silty clay to silty clay loam. The C horizon is predominantly silty clay loam, but some profiles have strata of silt loam and light silty clay and some have strata of very fine sandy loam or fine sand below a depth of 50 inches. Yellowish-brown, reddish-brown, and olive mottles are in the C horizon.

On the landscape Lamo soils are associated with Colo, Leshara, and Zook soils. They have calcium carbonate nearer the surface than do Colo soils; they are finer textured in the upper part of the C horizon than Leshara soils and are coarser textured in the C horizon than Zook soils.

Lamo silty clay loam, 0 to 2 percent slopes (La).—This soil is on bottom lands of the Elkhorn River valley and of other major stream valleys. It occurs in elongated areas that range from 10 to 100 acres in size. The profile of this soil is the one described as representative of the Lamo series.

Included with this soil in mapping were small areas of Colo, Leshara, and Zook soils, areas of Lamo silty clay loam, wet, 0 to 1 percent slopes, and areas of Lamo soils that have a light silty clay surface layer. Also included were a few wet spots and alkali spots.

Runoff is slow. Wetness delays tillage and planting in spring. Proper drainage and maintaining fertility are concerns of management.

Most of the acreage of this soil is cultivated. Corn, soybeans, and alfalfa are the principal crops. Some areas are used for pasture and native hayland. (Capability unit IIw-4; windbreak suitability group 2)

Lamo silty clay loam, wet, 0 to 1 percent slopes (Lb).—This soil is on some of the lowest bottom land in the county in areas that range from 4 to 100 acres in size. Depth to the water table is from 0 to 3 feet. The profile of this soil is similar to the one described as representative of the Lamo series, but the water table is at or nearer the surface, and the mottles are larger and occur higher in the profile.

Included with this soil in mapping were soils that are noncalcareous throughout the profile. Also included were soils having a loam surface layer that was deposited over the original soil.

Runoff is very slow. Wetness related to the high water table is the major limitation.

Most of the acreage of this Lamo silty clay loam is used for pasture and hay. Some trees are grown, but the species are limited to those that can tolerate excessive wetness. This soil is too wet for cultivation. It provides habitat for wildlife and areas for recreation. (Capability unit Vw-7; windbreak suitability group 6)

Lamo-Slickspots complex, 0 to 2 percent slopes (Lc).—This mapping unit is about 60 to 75 percent Lamo silty clay loam, and the remainder is Slickspots. It occurs in areas that range from 20 to about 130 acres in size. The profile of the Lamo part of this complex is the same as the one described as representative of the Lamo series, and the soil material in the Slickspots is described in the section on Slickspots. The surface layer in Slickspots is lighter colored and grayer than in Lamo soils, especially where the soil materials are dry. It also is more alkaline.

Included with this complex in mapping were small areas of Leshara soils and a few areas of soils that have a surface layer of silty clay.

Runoff ranges from slow to ponded. Wetness related to flooding and the comparatively high water table, which is at a depth of 2 to 8 feet, delays planting in spring in the Lamo-Slickspots complex. Workability is difficult because the soils have poor structure and are puddled. The alkalinity and poor physical condition of the areas of Slickspots are the principal limitations of this complex. Improving surface drainage, maintaining organic-matter content, and improving and maintaining fertility are concerns of management.

About 60 percent of the acreage of this mapping unit is cultivated. Corn, soybeans, and alfalfa are the principal crops. The remaining areas are used for pasture and hay. (Capability unit IVs–1; Lamo soil is in windbreak suitability group 2, and Slickspots is in windbreak suitability group 10)

Leisy Series

The Leisy series consists of deep, well-drained, gently sloping to moderately sloping soils. These soils formed on uplands in areas where eolian fine sand was deposited over loess.

In a representative profile, the surface layer is very friable fine sandy loam that is grayish brown in the upper 8 inches and dark grayish brown in the remaining 10 inches. The subsoil is very friable, grayish-brown loam in the upper 4 inches and is firm, brown silty clay loam to a depth of 60 inches. Reddish-brown mottles are below a depth of 32 inches.

Leisy soils have moderately slow permeability, high available water capacity, and moderate organic-matter content. They release moisture readily to plants. Reaction is slightly acid to a depth of 32 inches and is neutral below that depth.

These soils are suited to crops cultivated under dryland or irrigation management, to grass for pasture, and to trees and shrubs for windbreaks. They also provide food and habitat for wildlife.

Representative profile of Leisy fine sandy loam, 2 to 6 percent slopes, in a cultivated field, 2,500 feet north and 120 feet west of the southeast corner of sec. 23, T. 23 N., R. 4 E.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable; slightly acid; abrupt, smooth boundary.

A12—8 to 18 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to weak, medium and fine, subangular blocky; soft, very friable; slightly acid; clear, smooth boundary.

B1t—18 to 22 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 4/3) moist; weak, coarse, subangular blocky structure parting to weak, medium and fine, subangular blocky; slightly hard, very friable; many, fine tubular pores; slightly acid; clear, wavy boundary.

B21t—22 to 32 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate, coarse and medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; few sand grains on faces of peds; many, very fine, tubular pores; slightly acid, gradual, smooth boundary.

B22t—32 to 46 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; common, medium, prominent, reddish-brown (5YR 5/4) moist mottles in the lower part; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; few sand grains on face of peds; many, fine, tubular pores; neutral; clear, wavy boundary.

B3t—46 to 60 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; common, medium, prominent, reddish-brown (5YR 5/4) moist mottles; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; few sand grains on face of peds; many, very fine pores; neutral.

The A horizon ranges from 10 to 20 inches in thickness, from dark gray to grayish brown in color, and from loam to fine sandy loam in texture. The B horizon is from 28 to 50 inches thick. It is brown or grayish brown in the B1t layer and grayish brown to light yellowish brown in the B2t layer, which is silty clay loam or clay loam. The C horizon ranges from grayish brown to very pale brown in color and from light silty clay loam to loam in texture.

On the landscape Leisy soils are associated with Thurman and Moody soils. They are finer textured in all parts of the profile than Thurman soils and have a coarser textured A horizon than Moody soils. Leisy soils have a B horizon that is lacking in Thurman soils. They have a loam B1t horizon that is lacking in Moody soils.

Leisy fine sandy loam, 2 to 6 percent slopes (LeC).—This soil is on uplands in areas that range from 3 to about 120 acres in size. The profile of this soil is the one described as representative of the Leisy series.

Included with this soil in mapping were small areas of Thurman soils and of Leisy loam, 2 to 6 percent slopes. Also included were a few areas of soils that have a surface layer of loamy fine sand, small areas of soils in depressions that have a surface layer 18 to 25 inches thick, and small areas of soils that have underlying material of silty clay loam or silt loam. In some places, the underlying material has thin strata of fine sand below a depth of 48 inches.

Runoff is medium. Soil blowing is the principal hazard where this soil is cultivated. Maintaining the organic-matter content and improving fertility are concerns of management.

Nearly all of the acreage of this Leisy fine sandy loam is cultivated. Corn, soybeans, alfalfa, and grain sorghum are the principal crops. Small areas are used for pasture, for trees and shrubs for windbreaks, and for recreation. This soil provides habitat for wildlife. (Capability unit IIIe–3; windbreak suitability group 3)

Leisy fine sandy loam, 6 to 9 percent slopes (LeD).—This soil is on uplands in small, irregular areas that range from 4 to 10 acres in sizes. Its profile is similar to the one described as representative of the Leisy series, but the surface layer is slightly thinner.

Included with this soil in mapping were small areas of Thurman and Moody soils and of Leisy loam, 2 to 6 percent slopes. Also included were areas of sandy soils that were too small to show on the detailed map and that are indicated on the map by spot symbols.

Runoff is rapid. Water erosion and soil blowing are the principal hazards on this Leisy fine sandy loam. Maintaining the organic-matter content and improving fertility are concerns of management.

About half of the acreage of this soil is cultivated. Corn, oats, grain sorghum, and alfalfa are the principal crops. The remaining acreage is used mostly for pasture and hay. In some areas trees and shrubs are grown in windbreaks. This soil provides habitat for wildlife. (Capability unit IVe–3; windbreak suitability group 3)

Leisy loam, 2 to 6 percent slopes (LfC).—This soil is on upland divides and along drainageways. The areas are large and range from 20 to 70 acres in size. The profile of this soil is similar to the one described as representative of the Leisy series, but the surface layer is loam.

Included with this soil in mapping were small areas of Moody silty clay loam and Leisy fine sandy loam.

Runoff is medium. Water erosion and soil blowing are the principal hazards on this Leisy loam. Where this soil is cultivated, maintaining the fertility and organic-matter content are concerns of management.

Nearly all of the acreage of this soil is cultivated. Corn, soybeans, alfalfa, oats, and grain sorghum are the principal crops. Small areas are used for pasture and for windbreaks. (Capability unit IIe–1; windbreak suitability group 4)

Leshara Series

The Leshara series consists of deep, nearly level, somewhat poorly drained soils that formed in recent alluvium on bottom lands. These soils are subject to occasional flooding. The water table is at a depth of 2 to 8 feet.

In a representative profile, the surface layer is friable silt loam that is very dark gray in the upper 13 inches and dark gray in the remaining 4 inches. Beneath this is a transitional layer of gray, friable silt loam about 6 inches thick. The underlying material, which is below a depth of 23 inches, is gray silt loam in the upper part, light olive-gray silt loam in the middle part, and light-gray sandy loam in the lower part. Yellowish-brown mottles occur below the surface layer to a depth of 42 inches, and lime concretions occur in the upper part of the underlying material.

Leshara soils have moderate permeability, high available water capacity, and moderate organic-matter content. They release moisture readily to plants. Soil reaction is moderately alkaline except in the lower part of the surface layer, where it is mildly alkaline.

These soils are well suited to dryfarmed and irrigated crops, to grass, and to trees and shrubs. They also provide habitat for wildlife and areas for recreation.

Representative profile of Leshara silt loam, 0 to 2 percent slopes, in native grass, 540 feet west and 1,500 feet north of the southeast corner of SW1/4 sec. 28, T. 22 N., R. 6 E.:

A11—0 to 7 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak, fine and very fine, granular structure; slightly hard, friable; moderately alkaline; clear, smooth boundary.

A12—7 to 13 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak, fine, granular structure; slightly hard, friable; moderately alkaline; gradual, smooth boundary.

A13—13 to 17 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak, fine, subangular blocky structure parting to moderate, medium, granular; slightly hard, friable; mildly alkaline; gradual, smooth boundary.

ACca—17 to 23 inches, gray (5Y 5/1) silt loam, dark gray (5Y 4/1) moist; few, fine, faint, yellowish-brown (10YR 5/6) moist mottles; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; slightly hard, friable; slight effervescence; moderately alkaline; gradual, smooth boundary.

C1ca—23 to 31 inches, gray (5Y 6/1) silt loam, gray (5Y 5/1) moist; few, fine, faint yellowish-brown (10YR 5/6) moist mottles; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; slightly hard, friable; violent effervescence; few, soft, small lime concretions; moderately alkaline; gradual, smooth boundary.

C2ca—31 to 42 inches, light olive-gray (5Y 6/2) silt loam, olive gray (5Y 5/2) moist; few, fine, faint, yellowish-brown (10YR 5/6) moist mottles; massive; slightly hard, friable; violent effervescence; few, small, lime concretions, moderately alkaline; gradual, smooth boundary.

IIC3—42 to 60 inches; light-gray (5Y 7/2) sandy loam, olive gray (5Y 5/2) moist; massive; slightly hard, friable; slight effervescence; moderately alkaline.

The A horizon ranges from 10 to 22 inches in thickness and from very dark gray to dark grayish brown. It is mildly alkaline or moderately alkaline. The AC horizon is 4 to 7 inches thick and is gray or dark gray. The C horizon is gray to light gray and consists of very fine sandy loam, silt loam, and light silty clay loam. In some places, layers of sandy loam, loamy sand, and sand occur below a depth of 40 inches.

On the landscape Leshara soils are associated with Lamo, Wann, and Boel soils. They are coarser textured in the upper part of the C horizon than Lamo soils and finer textured in the upper part of the C horizon than Wann or Boel soils.

Leshara silt loam, 0 to 2 percent slopes (Lh).—This soil is on bottom lands in areas that range from 10 to 100 acres in size. Included with this soil in mapping were a few small areas of Wann, Boel, and Lamo soils and a few areas of soils that have a thin sandy loam surface layer. Also included were a few small areas where the surface layer and the upper part of the underlying material were mixed by deep plowing after sand had been deposited during floods.

Runoff is slow. Late in winter or early in spring, ice occasionally jams the rivers and streams and causes flooding. Wetness related to the moderately high water table delays tillage in spring and is the principal limitation of this soil. Soil blowing is a minor hazard. Maintaining soil fertility and organic-matter content are concerns of management.

Nearly all of the acreage of Leshara silt loam is cultivated. Corn, soybeans, and alfalfa are the principal crops. A few small areas are used for pasture and trees. (Capability unit IIw–4; windbreak suitability group 2)

Marsh

Marsh (Mh) consists of nearly level, very poorly drained soil material in wide, former channels of the Elkhorn River or in other areas that are slightly lower in elevation than the surrounding soils. Water from the Elkhorn River or from adjacent upland drainageways occasionally floods most of these areas. Marsh is covered with water throughout most of the year.

The surface layer of Marsh is dark gray and ranges from silt to clay. The underlying material is massive,

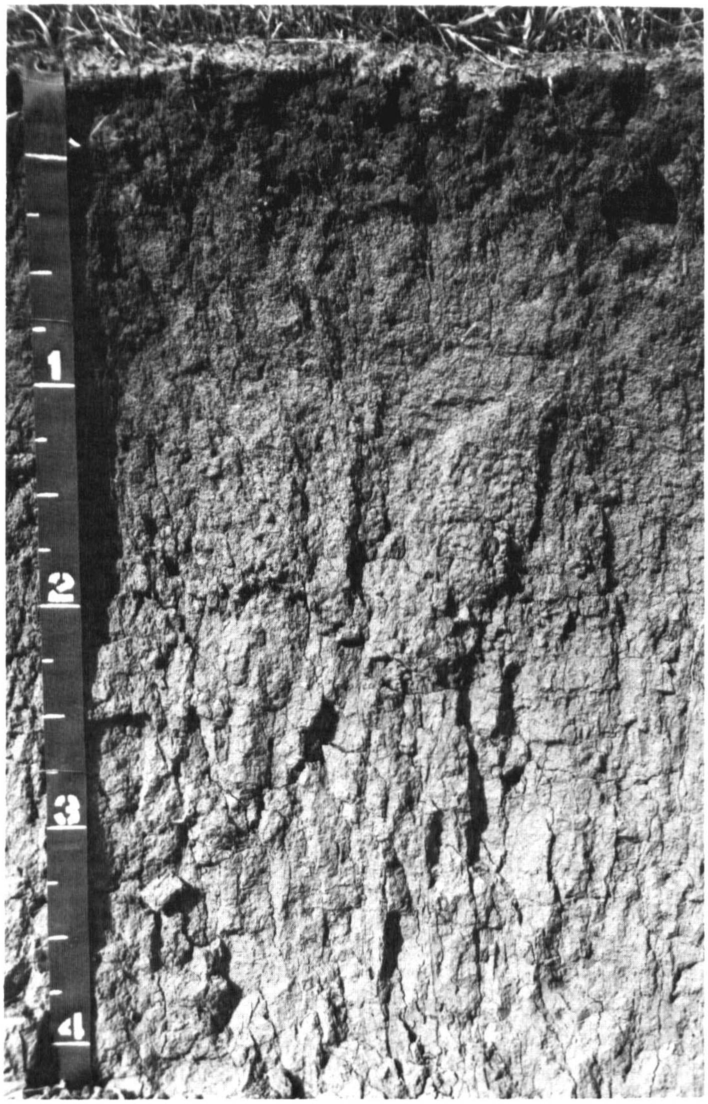

Figure 8.—**Profile of a Moody silty clay loam. This deep, well-drained soil has a well-developed subsoil of silty clay loam.**

gray silt loam. The organic-matter content is high, and the soil material is neutral or slightly alkaline.

Because of wetness, Marsh is not suited to cultivation. Draining this soil material generally is not economically feasible. The native vegetation consists mainly of cattails, sedges, rushes, and willows. Marsh is used almost exclusively as habitat for wetland wildlife and for recreation. (Capability unit VIIIw-7; windbreak suitability group 10)

Moody Series

The Moody series consists of deep, gently sloping to moderately sloping, well-drained soils on uplands. These soils formed in loess on broad, slightly convex divides and on concave hillsides that parallel intermittent drainageways.

In a representative profile (fig. 8), the surface layer is firm, very dark gray silty clay loam about 14 inches thick. The subsoil is firm silty clay loam that is brown in the upper 12 inches and yellowish brown in the remaining 20 inches. The underlying material, which is below a depth of 46 inches, is pale-brown silty clay loam in the upper part and pale-brown silt loam in the lower part. Yellowish-brown and gray mottles and small, soft lime segregations occur in the underlying material.

Moody soils have moderately slow permeability, high available water capacity, and moderate to moderately low organic-matter content. They release moisture readily to plants. Reaction is neutral except in the underlying material, which is moderately alkaline.

These soils are suited to cultivated crops, grass, trees, and shrubs. They also provide habitat for wildlife.

Representative profile of Moody silty clay loam, 2 to 6 percent slopes, in a cultivated field, 400 feet east and 150 feet north of the southwest corner of sec. 16, T. 21 N., R. 5 E.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak, fine, granular structure; hard, firm; neutral; abrupt, smooth boundary.

A12—8 to 14 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak, fine, subangular blocky structure parting to weak, fine and medium, granular; hard, firm; neutral; gradual, wavy boundary.

B21—14 to 18 inches, brown (10YR 4/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine and medium, subangular blocky structure; hard, firm; neutral; gradual, wavy boundary.

B22—18 to 26 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate, fine and medium, prismatic structure parting to moderate, fine, subangular blocky; hard, firm; neutral; gradual, wavy boundary.

B23—26 to 46 inches, yellowish-brown (10YR 5/4) silty clay loam, brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; neutral; gradual, wavy boundary.

C1ca—46 to 54 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; few, faint, fine, yellowish-brown (10YR 5/8) moist mottles; moderate, medium and coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; common, small, soft lime segregations; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2ca—54 to 60 inches, pale-brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) moist; few, faint, fine, yellowish-brown (10YR 5/8) moist and gray (10YR 6/1) moist mottles; weak, coarse, prismatic structure; slightly hard, friable; common, fine, soft lime segregations; strong effervescence; moderately alkaline.

The A horizon ranges from 6 to 15 inches in thickness and from very dark to dark grayish brown. The B horizon is 22 to 46 inches thick and is brown to light yellowish brown. The C horizon is pale brown or very pale brown and ranges from silty clay loam to silt loam in texture. Yellowish-brown, brown, grayish-brown, or gray mottles occur in the C horizon. Depth to calcium carbonate segregations ranges from 35 to 55 inches.

On the landscape Moody soils are associated with Belfore, Nora, Judson, and Crofton soils. They contain less clay, have weaker structure in the B horizon, and have calcium carbonate higher in the profile than Belfore soils; they contain more clay, have stronger structure in the B horizon, and are more deeply leached of calcium carbonate than Nora soils. Moody soils have a thinner A horizon than Judson soils. They have a thicker A horizon and more clay at a depth of 10 to 40 inches than Crofton soils, and they have a B horizon that is lacking in those soils.

Moody silty clay loam, 2 to 6 percent slopes (MoC).—This soil is on divides and hillsides on the loess uplands. The areas are irregular in shape and range from 10 to 60 acres in size. The profile of this soil is the one described as representative of the Moody series.

Included with this soil in mapping were small areas of Judson and eroded Moody silty clay loams and a few small areas of gently sloping Belfore and Nora silty clay loams. Also included were sandy soils and alkali soils in small areas that are shown on the detailed soil map by special spot symbols.

Runoff is medium. Water erosion is the principal hazard. The organic-matter content is moderate. Maintaining fertility and the organic-matter content are important concerns of management.

Nearly all of the acreage of this soil is cultivated. Corn, alfalfa, and soybeans are the principal crops. A small amount of oats and grain sorghum is grown. In a few areas trees and shrubs are planted in windbreaks, which provide habitat for wildlife. (Capability unit IIe–1; windbreak suitability group 4)

Moody silty clay loam, 2 to 6 percent slopes, eroded (MoC2).—This soil is on divides and hillsides of the loess uplands in long, narrow areas that range from 5 to 20 acres in size. Its profile is similar to the one described as representative of the Moody series, but the surface layer is thinner and lime is nearer the surface. Each year, plowing intermixes material from the surface layer with that in the upper part of the subsoil. For this reason, the surface layer commonly contains slightly more clay than does the surface layer in the uneroded Moody soils. Included in mapping were small areas of Nora soils.

Runoff is medium. Water erosion is the principal hazard on this eroded Moody silty clay loam. The organic-matter content is moderately low. Workability is only fair, because the plow layer includes some of the firm material from the subsoil. Controlling runoff, maintaining fertility, and improving the organic-matter content are important concerns of management.

Most of the acreage of this soil is cultivated. Corn, alfalfa, and soybeans are the principal crops. Grain sorghum and oats are grown in small amounts. Small areas near farmsteads are used for pasture and for windbreaks. (Capability unit IIe–1; windbreak suitability group 4)

Moody silty clay loam, 6 to 11 percent slopes (MoD).—This soil is on concave hillsides of the loess uplands in areas that range from 5 to 30 acres in size. The profile of this soil is similar to the one described as representative of the Moody series, but lime is nearer the surface.

Included with this soil in mapping were small areas of moderately steep, eroded Moody, Nora, and Judson soils. Also included were Slickspots, eroded soils, and sandy soils in small areas that are indicated on the detailed soil map by special spot symbols.

Runoff is rapid. Water erosion is the principal hazard where this Moody silty clay loam is cultivated. The organic-matter content is moderate. Improving fertility and the organic-matter content is an important concern of management.

Nearly all of the acreage of this soil is cultivated. Corn, alfalfa, and soybeans are the principal crops. Smaller amounts of oats and grain sorghum are grown. A few areas are in pasture and trees. This soil provides habitat for wildlife. (Capability unit IIIe–1; windbreak suitability group 4)

Moody silty clay loam, 6 to 11 percent slopes, eroded (MoD2).—This soil is on hillsides of loess uplands in irregularly shaped areas that range from 5 to 30 acres in size. Its profile is similar to the one described as representative of the Moody series, but lime is nearer the surface and the surface layer is thinner and lighter colored. Plowing intermixes the surface layer, which is from 6 to 8 inches thick, with the upper part of the subsoil.

Included with this soil in mapping were small areas of Nora and Crofton soils. Also included were sandy soils and Slickspots in small areas that are indicated on the detailed soil map by special spot symbols.

Runoff is rapid. Water erosion is the principal hazard on this eroded Moody silty clay loam. Workability is only fair because of the firm consistence. The organic-matter content is moderately low. Controlling runoff and improving fertility and the organic-matter content are concerns of management.

Nearly all of the acreage of this soil is cultivated. Corn, alfalfa, and soybeans are the principal crops. Oats and grain sorghum are grown in small amounts. A few small areas are in pasture and trees. This soil provides food and habitat for wildlife. (Capability unit IIIe–8; windbreak suitability group 4)

Nora Series

The Nora series consists of deep, well-drained, moderately sloping to moderately steep soils on uplands. These soils formed in thick deposits of silty loess on ridgetops and hillsides that border drainageways.

In a representative profile (fig. 9), the surface layer is very dark grayish-brown, friable silty clay loam about 12 inches thick. The subsoil is friable silty clay loam that is brown in the upper 18 inches and light yellowish brown in the remaining 9 inches. The underlying material, which is below a depth of 39 inches, is very pale brown silt loam. Yellowish-brown mottles occur below a depth of 30 inches. The soil is calcareous and has common, fine to medium, soft lime segregations below a depth of 20 inches.

Nora soils have moderate permeability and high available water capacity. They release moisture readily to plants. The organic-matter content is moderate except in eroded Nora soils, where it is low or moderately low. Reaction is neutral to a depth of 20 inches, below which it is strongly to moderately alkaline.

These soils are suited to cultivated crops, to pasture, and to trees and shrubs in windbreaks. They provide habitat for wildlife.

Representative profile of Nora silty clay loam, 6 to 11 percent slopes, in a cultivated field, 550 feet east and 100 feet north of the southwest corner of sec. 16, T. 21 N., R. 5 E.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak, fine and medium, granular structure; slightly hard, friable; neutral; abrupt, smooth boundary.

A12—8 to 12 inches, very dark grayish-brown (10YR 3/2)

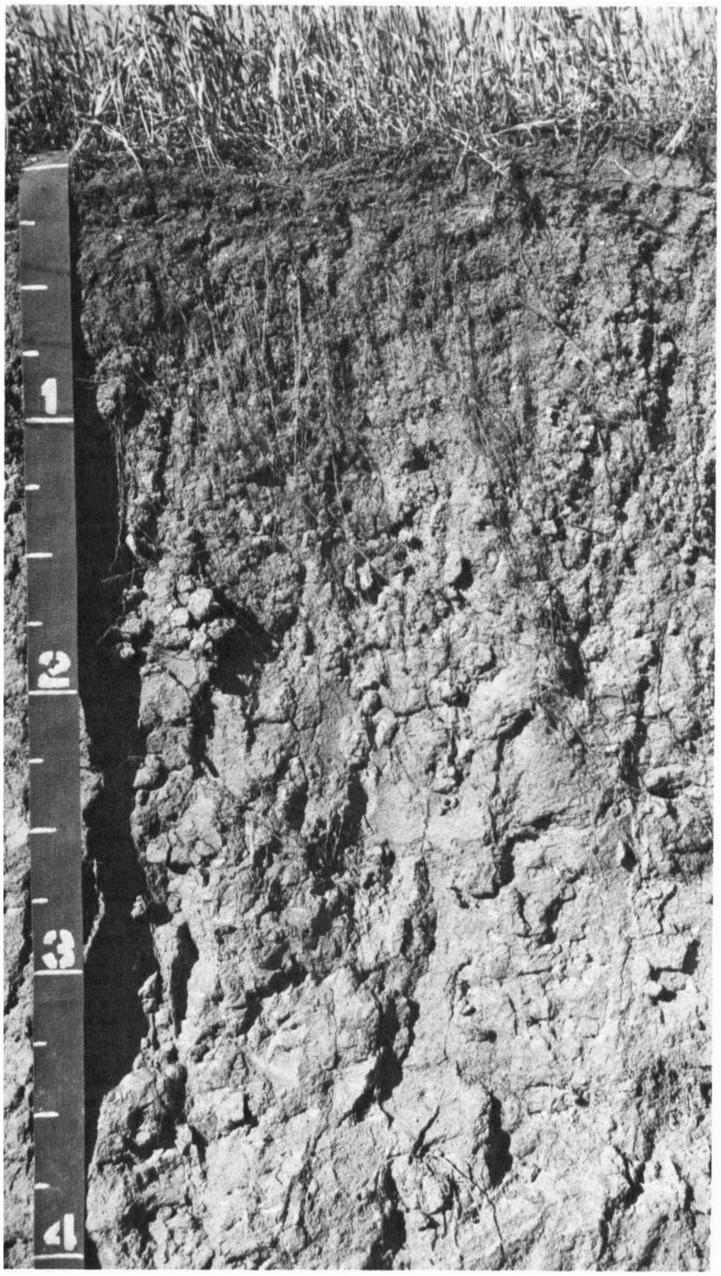

Figure 9.—**Profile of a Nora silty clay loam. This deep soil is calcareous below a depth of about 20 inches.**

silty clay loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky structure parting to weak, medium, granular; slightly hard, friable; neutral; gradual, wavy boundary.

B21—12 to 20 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; slightly hard, friable; neutral; gradual, wavy boundary.

B22ca—20 to 30 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; common, fine, soft lime segregations; strong effervescence; strongly alkaline; gradual, wavy boundary.

B23ca—30 to 39 inches, light yellowish-brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; few, fine, faint, yellowish-brown (10YR 5/8) moist mottles; weak, medium and coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; common, fine and medium, soft lime segregations; few lime concretions; strong effervescence; moderately alkaline; gradual, wavy boundary.

Cca—39 to 60 inches, very pale brown (10YR 7/4) silt loam, yellowish brown (10YR 5/4) moist; few, faint, fine, yellowish-brown (10YR 5/8) moist mottles; weak, coarse, prismatic structure; soft, very friable; common, fine and medium, soft lime segregations; few lime concretions; strong effervescence; moderately alkaline.

The A horizon ranges from 5 to 15 inches in thickness and is very dark grayish brown or dark grayish brown to dark gray. The B horizon ranges from 14 to 29 inches in thickness, from brown to light yellowish brown, and from light silty clay loam to silt loam. It is neutral to strongly alkaline. The C horizon is gray to very pale brown, is silt loam or light silty clay loam, and has yellowish-brown, brown, or reddish-brown mottles. Calcium carbonate occurs below a depth of 14 to 30 inches in uneroded areas and is at or near the surface in eroded areas.

On the landscape Nora soils are associated with Crofton and Moody soils. They have a thicker A horizon than Crofton soils and a thinner B horizon than Moody soils. The B horizon is lacking in Crofton soils. Lime is nearer the surface in Nora soils than in Moody soils.

Nora silty clay loam, 6 to 11 percent slopes (NoD).—This soil is on convex ridgetops and hillsides on loess uplands. Its profile is the one described as representative of the Nora series. Included with this soil in mapping were small areas of eroded Nora and Moody soils.

Runoff is rapid. Water erosion is the principal hazard on this Nora silty clay loam. The organic-matter content is moderate. Controlling runoff to reduce erosion and to conserve moisture is an important concern of management. Maintaining fertility and the organic-matter content is a concern where this soil is cultivated.

Nearly all of the acreage of this soil is cultivated. Corn, soybeans, alfalfa, and sorghum are the principal crops. A few areas are in pasture, and in a few areas trees and shrubs grow in windbreaks. (Capability unit IIIe-1; windbreak suitability group 4)

Nora silty clay loam, 6 to 11 percent slopes, eroded (NoD2).—This soil is on convex ridgetops and hillsides on loess uplands in areas that range from 4 to 40 acres in size. The profile of this soil is similar to the one described as representative of the Nora series, but lime is nearer the surface and the surface layer is thinner and slightly lighter colored. In plowed areas the material in the surface layer, which is from 5 to 7 inches thick, is mixed with that in the upper part of the subsoil.

Included with this soil in mapping were small areas of uneroded Nora soils and of eroded Crofton and Moody soils. These Moody soils are adjacent to narrow upland drainageways and are at lower elevations than the eroded Nora soils.

Runoff is rapid. Water erosion is a severe hazard on this eroded Nora silty clay loam. The organic-matter content is low. Improving fertility and the organic-matter content, reducing erosion, and conserving water are the major concerns of management where this soil is cultivated.

Nearly all of the acreage of this soil is cultivated. Corn, soybeans, alfalfa, and grain sorghum are the principal crops. A few areas are in pasture. Some trees and shrubs grow in farmstead windbreaks and provide habitat for wildlife. (Capability unit IIIe–8; windbreak suitability group 4)

Nora silty clay loam, 11 to 15 percent slopes (NoE).—This soil is on rounded ridgetops and on hillsides on loess uplands. It occurs mostly on west- and north-facing slopes in areas that range from 4 to 50 acres in size. The profile of this soil is similar to the one described as representative of the Nora series, but the surface layer is thinner and lime is nearer the surface.

Included with this soil in mapping were a few areas of eroded Crofton and Nora soils. Also included were small areas of Moody silty clay loam that are near drainageways and that are lower in elevation than the Nora soils.

Runoff is rapid. Water erosion, the principal hazard on this Nora silty clay loam, is severe where the soil is tilled or overgrazed. The organic-matter content is moderate. Controlling runoff to reduce erosion and to conserve moisture is the major concern of management. Maintaining fertility and the organic-matter content is a concern where the soil is cultivated.

Most of the acreage of this soil is cultivated. Corn, alfalfa, oats, and grain sorghum are the principal crops. Smaller amounts of soybeans are grown, but this crop leaves the soil more susceptible to erosion during winter and early in spring. Small areas are in pasture and trees. This soil provides habitat for wildlife. (Capability unit IVe–1; windbreak suitability group 4)

Nora silty clay loam, 11 to 15 percent slopes, eroded (NoE2).—This soil is on ridgetops and hillsides of the loess uplands. It usually occurs on north- or west-facing slopes in areas that range from 4 to 60 acres in size. The profile of this soil is similar to the one described as representative of the Nora series, but the surface layer is thinner and browner. Plowing mixes material in the surface layer, which is from about 5 to 7 inches thick, with that in the upper part of the subsoil. Included with this soil in mapping were small areas of uneroded Nora soils and of eroded Moody and Crofton soils.

Runoff is rapid. Water erosion is a severe hazard, and small gullies and rills commonly occur where the soil is left unprotected. Controlling runoff and reducing erosion are the primary concerns of management. The organic-matter content is moderately low. Improving fertility and the organic-matter content are important concerns.

About half of the acreage of this soil is cultivated. Corn, alfalfa, oats, and grain sorghum are the principal crops. Most of the remaining acreage is in pasture. In a few areas trees and shrubs are grown. (Capability unit IVe–8; windbreak suitability group 4)

Sandy Alluvial Land

Sandy alluvial land (0 to 2 percent slopes) (Sa) consists of very poorly drained, mixed alluvial material on the flood plain along the Elkhorn River. Most of this material is nearly level, but it is channeled in a few places. Generally it is flooded several times each year. The water table is at a depth of 2 to 8 feet.

This soil material consists of stratified layers of loamy sand and fine sand. Thin strata of sandy loam and silt loam commonly occur in the underlying material.

Sandy alluvial land has rapid permeability. Available water capacity and organic-matter content are low. Runoff is slow. Sandy alluvial land is not suited to cultivation, because it is susceptible to flooding. It is used almost exclusively for pasture. Woody vegetation consists mostly of willow and cottonwood trees. Little vegetation grows on the recent deposits of alluvial material. Sandy alluvial land provides habitat for wildlife. (Capability unit VIw–7; windbreak suitability group 10)

Silty Alluvial Land

Silty alluvial land (0 to 2 percent slopes) (Sy) consists of deep, very poorly drained alluvium on bottom lands in former channels of the Elkhorn River and in basinlike depressions adjacent to the present channel of the river. Fresh deposits of alluvium are added to these areas during the floods that occur several times each year. After floods, water remains on the surface until it soaks into the soil material or until it evaporates. During spring and early in summer, depth to the water table ranges from less than 1 foot to 3 feet.

The soil material in Silty alluvial land is variable. It consists mainly of very dark gray to dark grayish-brown stratified layers of silt loam and silty clay loam. Most of the material is calcareous.

Included with Silty alluvial land in mapping were areas of soil materials that have stratified layers of sandy loam, loamy sand, and fine sand below a depth of 16 inches. Such areas make up as much as 20 percent of the mapping unit in some places.

Silty alluvial land has moderately slow permeability. Available water capacity and organic-matter content are high. Runoff is very slow.

Silty alluvial land is not suited to cultivation, because it is susceptible to flooding. Most of the acreage is in trees, grass, and annual weeds. Some areas are used for pasture, and most provide habitat for wildlife. (Capability unit VIw–7; windbreak suitability group 10)

Slickspots

Slickspots consist of deep, nearly level, poorly drained soil material that formed in silty, loamy, and clayey alluvium on bottom lands. The material is strongly or very strongly alkaline. In this survey this soil material is mapped only as part of the Lamo-Slickspots complex. The water table in this mapping unit is at a depth of 2 to 6 feet.

The surface layer of Slickspots is sticky silty clay loam. It is about the same thickness as the plow layer. Beneath this, to a depth of 25 inches, is a transitional layer of very firm silty clay loam that is more blocky in structure than that in the surface layer. The underlying material consists of stratified layers of grayish silt loam, silty clay loam, and silty clay. In places, stratified layers of sand occur below a depth of 60 inches.

Slickspots have slow permeability. The available water capacity and organic-matter content are low. Runoff is very slow. Water commonly is ponded on the surface after rains. This soil material can hold a large amount of water but releases it slowly to plants. Slickspots are strongly alkaline or very strongly alkaline, and this causes the surface layer to become puddled when worked. Wetness and alkalinity are the principal limitations of this soil material.

Slickspots are better suited to grasses than to other purposes. However, most of the acreage is cultivated because this soil material is closely associated with Lamo soils. A small acreage is in grass. Slickspots are not suited to trees.

Thurman Series

This series consists of deep, somewhat excessively drained, nearly level to moderately sloping soils on uplands. These soils formed in eolian sands on elongated ridgetops that extend northwest to southeast.

In a representative profile, the surface layer is very friable loamy fine sand that is grayish brown in the upper 6 inches and dark grayish brown in the remaining 7 inches. Beneath this is a transitional layer of very friable, grayish-brown loamy fine sand about 6 inches thick. The underlying material, below a depth of 19 inches, is pale-brown fine sand in the upper part and light yellowish-brown fine sand in the lower part.

Thurman soils have rapid permeability, low available water capacity, and moderately low organic-matter content. They release moisture readily to plants. Reaction is slightly acid throughout the profile.

These soils are suited to grass and to trees and shrubs for windbreaks. Where slope is not more than 6 percent, the soils are suited to cultivation. They also provide habitat for wildlife.

Representative profile of Thurman loamy fine sand in an area of Thurman and Valentine loamy fine sands, 3 to 6 percent slopes, 264 feet east and 200 feet north of the southwest corner of SE1/4 sec. 24, T. 22 N., R. 6 E.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable; slightly acid; abrupt, smooth boundary.

A12—6 to 13 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, medium, blocky structure; soft, very friable; slightly acid; clear, smooth boundary.

AC—13 to 19 inches, grayish-brown (10YR 5/2) loamy fine sand; dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure; soft, very friable; slightly acid; clear, smooth boundary.

C1—19 to 34 inches, pale-brown (10YR 6/3) fine sand; grayish brown (10YR 5/2) moist; single grained; loose; slightly acid; gradual, smooth boundary.

C2—34 to 60 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; slightly acid.

The A horizon is from 10 to 19 inches thick and is very dark gray to dark grayish brown. The AC horizon ranges from 4 to 9 inches in thickness, from dark gray to brown, and from loamy fine sand to fine sand. The C horizon is grayish brown to light yellowish brown and is loamy fine sand or fine sand.

On the landscape Thurman soils are associated with Leisy and Valentine soils. They are coarser textured than Leisy soils and have a thicker A horizon than Valentine soils. Thurman soils do not have a B horizon, which is present in Leisy soils.

Thurman and Valentine loamy fine sands, 0 to 3 percent slopes (TvB).—These soils are on sandy uplands in irregularly shaped areas that range from 10 to 40 acres in size. The Thurman soil is dominant in most of these areas, although both soils generally occur. In some areas, the soil is largely Thurman loamy fine sand; in a few others, it is largely Valentine loamy fine sand.

The profile of the Thurman and Valentine soils is similar to the one described as representative of their respective series, but the surface layer is slightly thicker.

Included with these soils in mapping were a few small areas of soils having a surface layer of fine sand and areas of Thurman loamy fine sand that have silty material below a depth of 40 inches. Also included were soils in a few small depressional areas and wet spots that are shown on the detailed soil map by special spot symbols.

Runoff is slow. Because of their low available water capacity, Thurman and Valentine loamy fine sands are droughty. Soil blowing is a severe hazard where these soils are not protected by vegetation or organic matter. The leaching of plant nutrients by the available moisture is a limitation. Improving fertility and maintaining the organic-matter content are concerns of management.

Nearly all of the acreage of this mapping unit is cultivated. Corn, oats, grain sorghum, and alfalfa are the principal crops. Small areas are used for range. In some areas trees and shrubs grow in windbreaks. These soils provide nesting and food for grassland wildlife. (Capability unit IIIe–5; windbreak suitability group 3)

Thurman and Valentine loamy fine sands, 3 to 6 percent slopes (TvC).—These soils are on elongated ridgetops on sandy uplands in areas that range from 5 to 75 acres in size. Both Thurman and Valentine soils are in most of these areas, although Thurman loamy fine sand is the only soil in some small areas.

Thurman soils have a thicker surface layer than Valentine soils. The profile of the Thurman soil in this mapping unit is the one described as representative of the Thurman series. That of the Valentine soil is similar to the one described as representative of the Valentine series, but the surface layer is slightly lighter in color.

Included with these soils in mapping were small areas of Leisy soils, some areas of soils having a surface layer of fine sand, and some areas of soils that have silty material beneath a depth of 40 inches. Also included were soils in small depressions that are indicated on the detailed soil map by a special spot symbol.

Runoff is medium. Because of their low available water capacity, Thurman and Valentine loamy fine sands are droughty. Soil blowing is a severe hazard, especially where these soils are tilled or overgrazed. Maintaining fertility and improving the organic-matter content are concerns of management.

About 60 percent of the acreage of this mapping unit is cultivated. Corn, grain sorghum, and red clover are the principal crops. Most of the remaining acreage was formerly cultivated, but it has been reseeded to grass and is used for range and pasture. In some areas trees and shrubs grow in windbreaks. These soils provide habitat for wildlife. (Capability unit IVe–5; Thurman soil is in windbreak suitability group 3, Valentine soil is in windbreak suitability group 7)

Thurman and Valentine loamy fine sands, 6 to 11 percent slopes (TvD).—These soils are on sandy uplands in irregularly shaped areas that range from 6 to 15 acres in size. Both soils are in most of these areas, although the soil is largely Thurman loamy fine sand in some areas and is Valentine loamy fine sand in a few others.

Thurman soils have a thicker surface layer than Valentine soils. The profile of each soil in this mapping unit is similar to the one described as representative of its respective series, but the surface layer of both is thinner and is slightly lighter colored.

Included with these soils in mapping were small areas of Leisy soils and some areas of soils having silty loess material below a depth of 40 inches. Also included were small areas of silt loam that crops out at the surface in places and are indicated on the detailed soil map by special spot symbols.

Runoff is medium. Water erosion is a hazard on the steep areas. Because of their low available water capacity, these Thurman and Valentine loamy fine sands are droughty. Soil blowing is a severe hazard where these soils are tilled or overgrazed. Improving the organic-matter content and fertility is a concern of management.

About 60 percent of the acreage of this mapping unit is in grass. Most of the remainder is cultivated, but the hazard of erosion and the coarse texture and rolling slopes of these soils make them better suited to pasture and hay. Some trees and shrubs grow in windbreaks. These soils provide nesting and food for grassland wildlife. (Capability unit VIe–5; windbreak suitability group 7)

Valentine Series

The Valentine series consists of deep, nearly level to moderately sloping, excessively drained soils that formed in eolian sands on uplands.

In a representative profile, the surface layer is loose, dark grayish-brown loamy fine sand about 5 inches thick. Beneath this is a transitional layer of loose grayish-brown fine sand that is about 2 inches thick. Below a depth of 7 inches, the underlying material is fine sand that is light yellowish brown in the upper part and very pale brown in the remainder of the profile.

Valentine soils have rapid permeability, low available water capacity, and low organic-matter content. They release moisture readily to plants. Reaction is slightly acid except in the lower part of the underlying material, where it is neutral.

These soils are suited to grass and to trees and shrubs in windbreak plantings. Where their slope is not too steep or where their texture is not too coarse, these soils also are suited to cultivated crops. They provide habitat for rangeland wildlife.

Representative profile of Valentine loamy fine sand, 3 to 10 percent slopes, in native grass, 760 feet north and 280 feet west of the southeast corner of sec. 7, T. 23 N., R. 4 E.:

A—0 to 5 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; loose; slightly acid; abrupt, smooth boundary.

AC—5 to 7 inches, grayish-brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure; loose; slightly acid; abrupt, smooth boundary.

C1—7 to 18 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; weak, coarse, prismatic structure; loose; slightly acid; gradual, smooth boundary.

C2—18 to 60 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; neutral.

The A horizon ranges from 5 to 8 inches in thickness and is very dark grayish brown or dark grayish brown. The AC horizon ranges from grayish brown and brown to light yellowish brown and pale brown.

On the landscape Valentine soils are associated with Thurman and Leisy soils. They have a thinner A horizon and a coarser textured C horizon than Thurman soils and a coarser textured, thinner A horizon than Leisy soils. Valentine soils lack the loamy B horizon of the Leisy soils.

Valentine loamy fine sand, 3 to 10 percent slopes (VaD).—This soil is on long, narrow ridgetops on sandy uplands. The areas range from 3 to 100 acres in size. Included with this soil in mapping were small areas of Thurman soils and a few acres of blowouts.

Runoff is medium. Valentine loamy fine sand is droughty because of its low available water capacity. Soil blowing is a severe hazard.

Most of the acreage of this soil is in grass and is used for range. Some areas were formerly cultivated but are now reseeded to native grasses. (Capability unit VIe–5; windbreak suitability group 7)

Wann Series

The Wann series consists of deep, nearly level, somewhat poorly drained soils that formed in alluvium on bottom lands in the Elkhorn River valley. In places, these soils are subject to flooding. The water table is at a depth of 3 to 8 feet.

In a representative profile, the surface layer is very friable loam that is dark gray in the upper 7 inches and gray in the remaining 5 inches. The underlying material is calcareous fine sandy loam to a depth of 48 inches; it is gray in the upper part, grayish brown in the middle part, and light brownish gray in the lower part. Beneath this is light-gray and white fine sand. Yellowish-brown mottles occur between depths of 18 and 54 inches.

Wann soils have moderately rapid permeability, high available water capacity, and moderate organic-matter content. They release moisture readily to plants. Reaction is neutral in the surface layer and slightly alkaline, mildly alkaline, or neutral in the underlying material.

These soils are suited to cultivated crops, grass, and trees. They also provide habitat for wildlife.

Representative profile of Wann loam, 0 to 2 percent slopes, in a cultivated field, 150 feet south and 300 feet east of the center of sec. 11, T. 23 N., R. 4 E.:

Ap—0 to 7 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak, fine, subangular blocky structure parting to weak, fine, granular; slightly hard, very friable; neutral; abrupt, smooth boundary.

A12—7 to 12 inches, gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure parting to weak, fine, granular; slightly hard, very friable; neutral; abrupt, smooth boundary.

C1—12 to 18 inches, gray (10YR 5/1) fine sandy loam, dark gray (10YR 4/1) moist; weak, medium, prismatic structure parting to weak, fine, blocky; slightly hard, very friable; slight effervescence; slightly alkaline; clear, wavy boundary.

C2—18 to 31 inches, grayish-brown (10YR 5/2) fine sandy loam, dark gray (10YR 4/1) moist; few, fine, faint, yellowish-brown (10YR 5/4) moist mottles; weak, coarse, prismatic structure; soft, very friable; slight effervescence; mildly alkaline; clear, wavy boundary.

C3—31 to 48 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark gray (10YR 4/1) moist; few, fine, faint, yellowish-brown (10YR 5/6) moist mottles; weak, coarse, prismatic structure; soft, very friable; slight effervescence; mildly alkaline; abrupt, smooth boundary.

C4—48 to 54 inches, light-gray (10YR 7/1) fine sand, gray (10YR 5/1) moist; few, fine, faint, yellowish-brown (10YR 5/6) moist mottles; single grained; loose; mildly alkaline; clear, wavy boundary.

C5—54 to 60 inches, white (10YR 8/1) fine sand, light gray (10YR 6/1) moist; single grained; loose; mildly alkaline.

The A horizon ranges from 12 to 20 inches in thickness and is gray or dark gray. It is neutral or mildly alkaline. The C horizon ranges from fine sandy loam to sandy loam to a depth of 40 inches and from very fine sandy loam to fine sand below that depth. Stratification with medium to coarse material is common.

On the landscape Wann soils are associated with Leshara, Boel, and Inavale soils. They are coarser textured in the upper part of the C horizon than Leshara soils and are finer textured in the upper part of the C horizon than Boel and Inavale soils.

Wann loam, 0 to 2 percent slopes (Wm).—This soil is on bottom lands in irregular areas that range from 10 to 100 acres in size. Included in mapping were small areas of Leshara silt loam, Boel loam, and Inavale loamy fine sand. Also included were small areas of fine sand and small depressions that are shown on the detailed soil map by special spot symbols.

Runoff is slow. Early in spring, occasional flooding is a minor hazard on Wann loam. Wetness related to the moderately high water table delays spring tillage and planting and is the principal limitation. This soil does not warm up as readily in the spring as soils that are better drained.

Most of the acreage of this soil is cultivated. Corn, alfalfa, and soybeans are the principal crops. Small amounts of grain sorghum and oats are grown. Small areas are in grass, and trees and shrubs are planted in windbreaks. This soil provides food and nesting for openland wildlife. (Capability unit IIw-4; windbreak suitability group 2)

Zook Series

The Zook series consists of deep, nearly level, somewhat poorly drained soils that formed in silty and clayey alluvium on bottom lands. These soils are subject to occasional flooding. The water table is at a depth of 3 to 8 feet.

In a representative profile, the surface layer is firm, very dark gray heavy silty clay loam to a depth of 19 inches and, beneath this, firm, very dark gray silty clay to a depth of 32 inches. The subsoil is firm, dark-gray silty clay about 15 inches thick. The underlying material, which is below a depth of 47 inches, is gray silty clay that has reddish-brown mottles.

Zook soils have slow permeability, high available water capacity, and high organic-matter content. These soils release moisture slowly to plants. Reaction is slightly acid in the upper 7 inches and neutral in most of the remainder of the profile.

These soils are suited to cultivated crops and also can be used for grass, trees, and shrubs. They provide habitat for openland wildlife.

Representative profile of Zook silty clay loam, 0 to 2 percent slopes, in bromegrass, 1,200 feet west and 120 feet south of the northeast corner of sec. 30, T. 23 N., R. 6 E.:

Ap—0 to 7 inches, very dark gray (10YR 3/1) heavy silty clay loam, black (10YR 2/1) moist; moderate, fine and medium, granular structure; hard, firm; slightly acid; clear, smooth boundary.

A12—7 to 19 inches, very dark gray (10YR 3/1) heavy silty clay loam, black (10YR 2/1) moist; weak, medium, subangular blocky structure parting to weak, fine and medium, granular; hard, firm; neutral; gradual, smooth boundary.

A3—19 to 32 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; moderate, medium, subangular blocky structure parting to moderate, medium, granular; hard, firm; slightly acid; gradual, smooth boundary.

Bg—32 to 47 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate, medium, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm; neutral; gradual, smooth boundary.

C—47 to 60 inches, gray (10YR 5/1) silty clay, very dark grayish brown (10YR 3/2) moist; few, fine, faint reddish-brown (5YR 4/4) moist mottles; massive; hard, very firm; neutral.

The A horizon ranges from 24 to 34 inches in thickness, and the B horizon from 13 to 17 inches. These horizons are dark gray or very dark gray. All horizons are heavy silty clay loam or silty clay, or a combination of these. The C horizon, which is below depths ranging from 37 to 51 inches below the surface, is dark gray to grayish brown and has reddish-brown or brown mottles.

On the landscape Zook soils are associated with Colo and Kennebec soils. They have a clayey B horizon that is absent in Colo and Kennebec soils. The water table is nearer the surface in Zook soils than in Kennebec soils.

Zook silty clay loam, 0 to 2 percent slopes (Zo).—This soil is on bottom lands of the major streams in the county. The areas range from 60 to 120 acres in size. The profile of this soil is the one described as representative of the Zook series.

Included with this soil in mapping were small areas of Colo silty clay loam and Zook silty clay. Also included were a few small areas of soils that have a silt loam surface layer about 8 to 10 inches thick and small areas on bottom lands along the Elkhorn River, where the soils have lime higher in the profile than is typical for the Zook soils.

Runoff is very slow. Wetness related to flooding and to the comparatively high water table delays tillage and planting early in spring and is the principal limiting factor. Zook silty clay loam warms more slowly in the spring than well-drained soils. Maintaining fertility is a concern of management.

Nearly all of the acreage of this soil is cultivated. Corn, soybeans, and alfalfa are the principal crops. Small areas are used for grass and trees. (Capability unit IIw–4; windbreak suitability group 2)

Zook silty clay, 0 to 2 percent slopes (Zw).—This soil is on bottom lands of the major streams of the county in areas that range mostly from 20 to 100 acres in size. The profile of this soil is similar to the one described as representative of the Zook series, but the surface layer is silty clay.

Included with this soil in mapping were a few areas of Colo soils and small areas of wet spots and alkali spots. Also included in the Elkhorn River valley were areas of a soil that has lime in the underlying material.

Runoff is very slow. Wetness related to flooding and to the comparatively high water table delays tillage and planting in the spring and is the principal limitation. When weather permits, some areas are tilled in the fall to allow earlier planting the following spring. Zook silty clay warms up slowly. Maintaining fertility, improving runoff, and providing protection from flooding are concerns of management.

Nearly all of the acreage of this soil is cultivated. Corn, soybeans, and alfalfa are the principal crops. Small areas are planted to grass and are used as pasture. In a few areas trees and shrubs are planted in windbreaks. (Capability unit IIIw–1; windbreak suitability group 2)

Use and Management of the Soils

This section provides information on the use and capabilities of the soils of Cuming County. A general discussion of management practices is followed by an explanation of the capability classification used by the Soil Conservation Service and a grouping of the soils into units according to that classification. Management of rangeland is discussed briefly. Information is presented on native woodland, on the suitability of the soils in the county for windbreaks, and on the species of trees suited to each soil. The wildlife and habitat for wildlife are discussed for each of the soil associations. The section concludes with a description of the engineering properties of the soils, interpretations of engineering test data for each of the soil series, and a discussion of the importance of each soil for engineering purposes.

Use of the Soils for Crops [2]

Most of the soils in Cuming County are fertile and, under proper management, are well suited to crops. The principal concerns of management are water erosion, soil blowing, loss of fertility, leaching, and flooding adjacent to streams. About 6 percent of the soils in the county have slopes greater than 10 percent. Because runoff is sometimes excessive, the hazard of water erosion is severe on soils on uplands. In many places on the steeper soils, sheet and gully erosion have washed away much of the original surface layer, and the soil material has been deposited in the valleys. Runoff from heavy rains on the steeper areas sometimes causes flooding and damage to crops on the bottom lands.

Corn is the major cultivated crop in Cuming County. Alfalfa is the next most important crop, and soybeans rank third in acreage. Grain sorghum, wheat, barley, and rye are grown in smaller amounts. Sizable acreages of row crops are grown on Belfore, Moody, and Nora soils on the uplands and on Kennebec, Colo, Leshara, and Zook soils on the bottom lands.

Pasture in the county is principally cool-season grasses, such as bromegrass or orchardgrass mixed with alfalfa. A minor acreage is planted to a warm-season grass mixture, mostly native grasses. One pasture of cool-season grasses and another of warm-season grasses can be placed in combination for a long season of grazing. In some places, pasture is part of a long-time cropping system and is alternated with cultivated row crops. Some of the pasture, however, is on bottom lands that are subject to frequent flooding and thus are not suitable for cultivated crops. Flood control on these bottom lands, most of which are in valleys of the principal streams, is too major an operation for individual farmers. Where flooding is a hazard, losses are less if the soils are used for pasture than if they are used for cultivated crops. The acreage of pasture could be increased by seeding wet areas on bottom lands to tame grass. Also, some of the strongly sloping and moderately steep soils could be seeded to native grasses and used as range.

Managing dryfarmed soils

On the gently sloping and moderately sloping Moody, Nora, and Judson soils, erosion can be controlled by terracing, contour farming, establishing grassed waterways, and using cropping systems that include mulch tillage and the limited use of row crops. Soil losses from soil blowing and water erosion can be reduced by leaving crop residue on the surface of the soil during tillage operations. Stubble mulching and till-plant methods of seedbed preparation reduce runoff and loss of topsoil. Producing sufficient crop residue to control erosion on the steeper Crofton, Moody, and Nora soils is not always possible. As these soils need a grass cover that provides protection against water erosion, their best use is for pasture or hay crops. When used for pasture, the grasses should be maintained at a height of at least 4 inches. Soils on bottom lands, such as those in the Calco, Colo, Kennebec, and Zook series, are more productive when protected from flooding. Runoff received from areas on uplands by soils subject to flooding can be controlled by constructing diversion terraces and by using other practices that help conserve soil and water.

Soils that are to be cultivated should be tested to determine the type of commercial fertilizer needed. The amount of fertilizer to be applied depends on the amount of moisture in the soil. Less fertilizer should be used during periods of low rainfall than during periods of average or above-average rainfall. Crops on nearly all soils in the county respond well to nitrogen. Phosphorus and zinc generally are needed on the eroded Moody, Nora, and Crofton soils.

[2] By ERWIN O. PETERSON, conservation agronomist, Soil Conservation Service.

Managing irrigated soils

Only a small percentage of the cropland in Cuming County is irrigated. In 1971, according to the Nebraska Agricultural Statistics Report, 7,400 acres were irrigated with water from 52 wells. Irrigation water is used primarily to supplement natural rainfall during dry growing seasons. Where an adequate quantity of underground water is available, there is a potential for increasing the amount of irrigation.

Soils that are level or gently sloping are better suited to irrigation than other soils. If slopes are more than 8 percent, irrigation causes severe erosion and excessive runoff results in a loss of irrigation water.

In Cuming County, the furrow method of irrigating is used only for row crops on slightly sloping soils. With this method, furrows between the rows are used to convey water through the field. The sprinkler method is used on the nearly level soils and also on the rolling, sloping soils, where the cost of leveling would be prohibitive. With this method, water generally is applied at a rate that the soil can absorb without runoff. Because the amount of water can be carefully controlled, sprinklers are especially useful for establishing new pastures on moderately steep areas. In summer, however, wind shift and water loss through evaporation can cause an uneven application of water from some sprinkler irrigation systems.

Irrigation water should be applied frequently enough to keep the root zone moist during the growing season. The intervals between applications should vary according to the crop and to the time of year. Water should not be applied faster than the soil can absorb it, and the amount applied should not exceed the moisture-holding capacity of the soil. The deep soils in Cuming County can hold about 2 inches of water per foot of soil depth. Thus, a soil that is 4 feet deep can hold about 8 inches of water, which would be available to a crop that extends its roots to that depth.

Irrigated crops generally have higher yields than dryfarmed crops, and they remove more nitrogen, phosphorus, and other plant nutrients from the soil. Supplies of plant nutrients can be restored by returning crop residue to the soil and by adding manure and commercial fertilizer. Most irrigated crops in Cuming County respond to nitrogen. Crops on soils disturbed during land leveling operations, particularly where the topsoil has been removed, also respond to applications of phosphorus, zinc, and iron. The kinds and amounts of fertilizer needed for specific irrigated crops should be determined by soil tests.

Irrigation water, in addition to the natural rainfall, can cause serious erosion of sloping soils. Terracing, contour farming, mulch tillage, and crop rotation are important management practices for controlling erosion where sloping soils are irrigated.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so 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 horticultural crops or to other crops requiring 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 engineering.

In the capability system, the kinds of soils 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, range, woodland, or wildlife.
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife. There are no Class VII soils in Cuming County.
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry. There are no soils in the *c* subclass in Cuming County.

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, though 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. 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–1 or IIIe–8. 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.

Management by capability units

Each of the capability units in Cuming County is discussed in the pages that follow. The common features of the soil in each unit are given first, and then management practices are described. Because the irrigated acreage is so small, only the management of dry-farmed soils is discussed. Crops suited to this kind of management are given, and hazards and limitations are described, together with practices that help overcome them.

CAPABILITY UNIT I–1

This unit consists of deep, nearly level, well-drained or moderately well drained soils on upland divides, stream terraces, and bottom lands. The surface layer of these soils is silt loam or silty clay loam. Some soils have a subsoil of silty clay loam and silty clay, and some have a transitional layer of silt loam beneath the surface layer. The underlying material is silty clay loam.

Available water capacity and organic-matter content of soils in this unit are high. Permeability is moderate or moderately slow. Runoff is slow. These soils have good workability and are easily penetrated by roots, air, and water. They release moisture readily to plants. The soils on bottom lands are subject to minor, infrequent flooding. Maintaining fertility is a concern of management.

Soils in this unit are among the best in Cuming County for cultivated crops. They are well suited to pasture and to all crops commonly grown in the county (fig. 10). They are especially suited to row crops such as corn, soybeans, and grain sorghum. Row crops can be grown year after year if proper amounts of fertilizer are added and if weeds, disease, and insects are controlled. Crops on these soils respond well to nitrogen fertilizer.

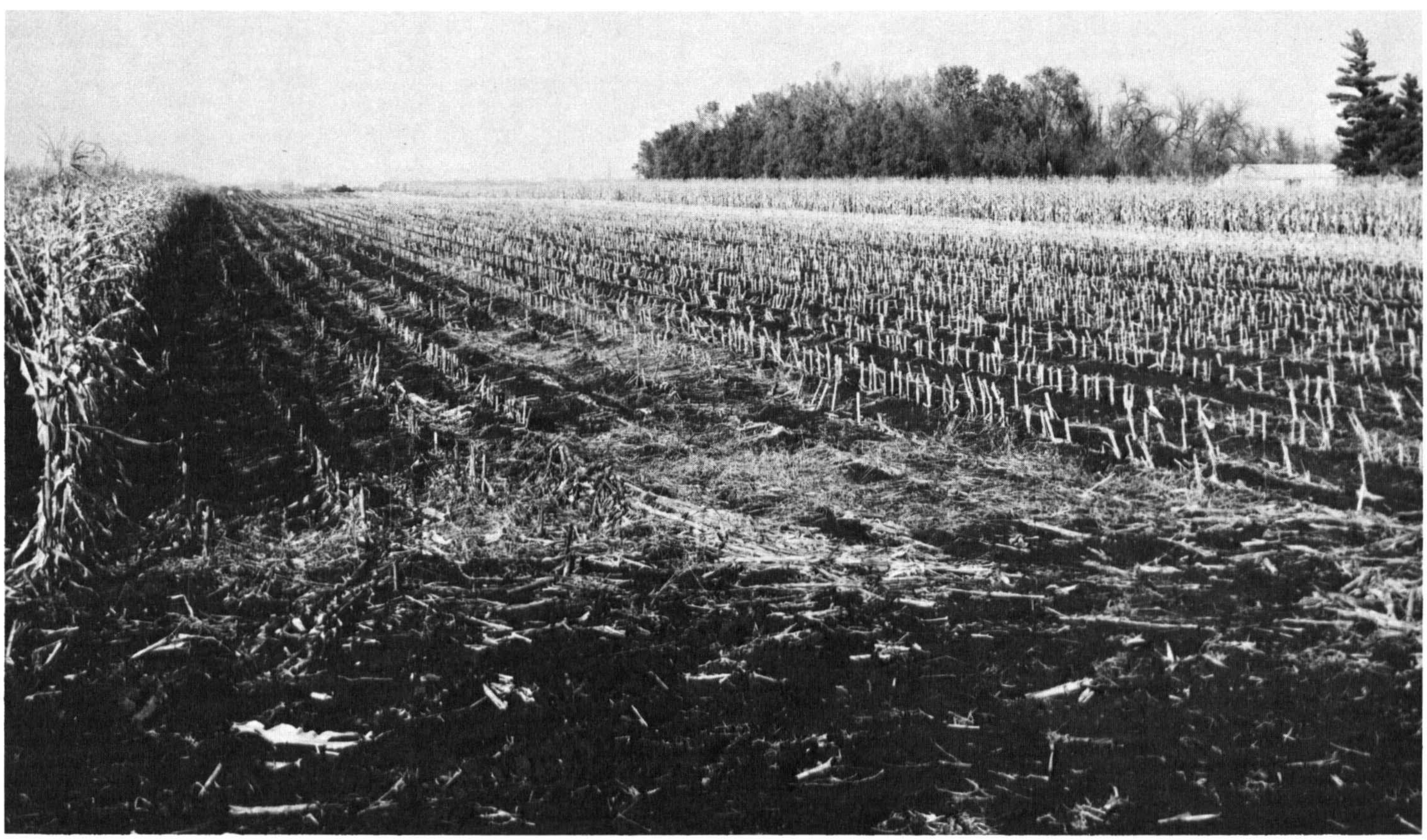

Figure 10.—**A nearly level area of a Belfore silty clay loam produces forage and grain crops used in feeding livestock. This soil is in capability unit I–1.**

Grassed waterways are useful for conducting runoff across soils in this unit. In places, diversion ditches reduce damage by runoff received from soils at higher elevations. Planting grass in the turnrows helps to control weeds along field borders. Fertility can be maintained by the use of commercial fertilizers.

CAPABILITY UNIT IIe-1

The unit consists of deep, well-drained soils on uplands and stream terraces. These soils are gently sloping, and erosion is slight or moderate. They have a surface layer and subsoil of silty clay loam. Some of these soils have underlying material of silty clay loam or silt loam.

Available water capacity of soils in this unit is high, and organic-matter content ranges from high to moderately low. Permeability is moderate or moderately slow. Runoff is medium. Some of these soils are slightly acid. Soils in this unit have good workability and are easily penetrated by roots, air, and water. They absorb moisture easily and release it readily to plants. Where these soils are cultivated, erosion by water is the principal hazard and maintaining fertility is a concern of management.

These soils are suited to all crops commonly grown in the county. Corn, oats, soybeans, alfalfa, barley, and rye are the principal crops. Soils in this unit are also well suited to trees, pasture grasses, and garden crops. In the year preceding the establishment of a legume crop, lime should be added to some of these soils to neutralize the acidity; the amount of lime needed should be determined by soil tests.

Leaving crop residue on the surface of the soils and including grasses and legumes in the cropping system help to control erosion and to improve organic-matter content, fertility, and tilth. Terraces, contour farming, and grassed waterways help to prevent damage by runoff on long slopes. Use of commercial fertilizers aids in maintaining fertility.

CAPABILITY UNIT IIs-6

Cass fine sandy loam, 0 to 2 percent slopes, is the only soil in this unit. It is a deep, nearly level, well-drained soil on bottom lands. The surface layer is fine sandy loam. Beneath this layer is a transitional layer of sandy loam. The underlying material consists of stratified loamy fine sand, fine sandy loam, and fine sand.

Available water capacity and organic-matter content of this soil are moderate. Permeability is moderately rapid. Runoff is slow. This soil is slightly acid and has good workability. It absorbs water easily and releases moisture readily to plants. Soil blowing is a hazard where the soil is not protected. This soil is subject to minor, infrequent flooding and to the leaching of plant nutrients. Maintaining fertility is a concern of management.

This soil is suited to all crops commonly grown in the county. The year before alfalfa is to be planted, lime may need to be incorporated into the topsoil during seedbed preparation for the crop that precedes the alfalfa; the amount of lime needed should be determined by soil tests.

Leaving crop residue on the surface of the soil helps to control soil blowing and improves fertility. A cropping system that includes grasses and legumes and the addition of commercial fertilizers aids in maintaining soil fertility.

CAPABILITY UNIT IIw-3

Kennebec silt loam, overwash, 0 to 2 percent slopes, is the only soil in this unit. It is a deep, nearly level, moderately well drained soil on bottom lands. The surface layer and the transitional layer beneath the surface layer are silt loam. The underlying material is silt loam and silty clay loam.

Available water capacity is high, and the organic-matter content and permeability are moderate. Runoff is slow. This soil absorbs moisture easily and releases it readily to plants. It is subject to occasional flooding for short periods following heavy rains in spring or early in summer. Water erosion is the principal hazard.

This soil is suited to pasture and to all crops commonly grown in the county. If this soil is properly managed, row crops can be grown year after year. Wetness, however, sometimes delays planting and tillage, and silty deposits left by floodwater occasionally damage crops and pasture. When not too rapid, runoff from adjacent soils at higher elevation benefits crops in dry years.

Terraces on the adjacent uplands, diversion ditches, and grassed waterways reduce runoff and help to control erosion. Because drainage ditches can become clogged by or filled with silt from floodwaters, they need to be cleaned and maintained. Productivity can be maintained by using fertilizers and by returning crop residue to the soils as mulch material.

CAPABILITY UNIT IIw-4

This unit consists of deep, nearly level, somewhat poorly drained soils on bottom lands. The profiles of these soils differ widely. The texture of the surface layer ranges from loam to silty clay. Some soils have a subsoil of silty clay loam or silty clay; and some have a transitional layer of silt loam or silty clay loam. The underlying material ranges from fine sandy loam to silty clay.

Available water capacity of soils in this unit is high. Organic-matter content is moderate or high, and permeability is moderately rapid to slow. Runoff is slow or very slow. Depth to the water table ranges from 2 to 8 feet. When rainfall is heavy, runoff from adjacent soils at higher elevations causes flooding. After periods of excessive rain, some areas are difficult to till. Most of these soils, however, generally absorb moisture easily and release it slowly to plants. Wetness is the principal hazard.

These soils are suited to pasture and to most crops commonly grown in the county. Corn and soybeans are the principal grain crops. Wetness commonly delays planting and tillage. Small grain crops that generally are seeded early in spring are not grown on these soils, because of excessive wetness at planting time. Alfalfa production varies: while the water table remains nearly constant or declines at a slow rate, alfalfa growth is promoted by subirrigation; a fast rise of the water table, however, can result in drowning of alfalfa roots. Most of the pasture (fig. 11) in Cuming County

Figure 11.—Cattle grazing on bromegrass and alfalfa. The soil is a Calco silty clay loam.

Figure 12.—A concrete interceptor tile drain being installed in a field of Zook silty clay loam, 0 to 2 percent slopes.

is on these soils. Losses from flooding are not severe where the soils are used for pasture grasses.

Terraces, diversion ditches, and grassed waterways on adjacent soils at higher elevations reduce runoff onto soils in this unit and thereby help to lessen flood damage. Where suitable outlets are available, tile drains help to lower the water table and to control wetness (fig. 12). Shallow surface drains can be used where the water table is not too close to the surface.

CAPABILITY UNIT IIIe-1

This unit consists of deep, well-drained soils on loess uplands. These soils are moderately sloping and are slightly eroded. They have a silty clay loam surface layer and subsoil. The underlying material is silt loam or silty clay loam.

Available water capacity is high, and the organic-matter content is moderate. Permeability is moderate or moderately slow. Runoff is rapid. These soils have good workability and are easily and deeply penetrated by roots. They absorb moisture easily and release it readily to plants. Erosion is the principal hazard on these soils. Maintaining fertility and good soil structure, controlling surface water, and conserving moisture are important concerns of management.

These soils are suited to most crops commonly grown in the county. They are highly erodible if soybeans are grown.

Terracing, contour farming, and grassed waterways aid in controlling runoff and preventing erosion. Leaving crop residue on the surface of the soil and mulch tilling also help to control erosion and to improve fertility and soil structure. Fertility can be maintained by applying commercial fertilizer or barnyard manure.

CAPABILITY UNIT IIIe-3

Leisy fine sandy loam, 2 to 6 percent slopes, is the only soil in this unit. It is a deep, loamy, well-drained, gently sloping soil on uplands. This soil has a fine sandy loam surface layer and a subsoil that is loam in the uppermost part and silty clay loam below.

Available water capacity is high. Organic-matter content is moderate, and permeability is moderately slow. Runoff is medium. This soil has good workability. It absorbs moisture easily and releases it readily to plants. Where this soil is cultivated, soil blowing and water erosion are the principal hazards.

This soil is suited to most crops commonly grown in the county. It is highly erodible where soybeans are grown.

Terracing, contour farming, stripcropping, and grassed waterways help to control erosion. Tillage should be kept to a minimum. Field windbreaks planted along field borders reduce soil blowing. Including legumes or a mixture of grasses and legumes in the cropping system helps to replenish the supply of organic matter, to maintain fertility, and to control soil blowing. Alternating close-growing crops and leaving crop residue on the surface of the soil help to improve the soil and to control soil blowing.

CAPABILITY UNIT IIIe-5

Thurman and Valentine loamy fine sands, 0 to 3 percent slopes, are the only soils in this unit. These are deep, nearly level to very gently sloping soils on uplands. They are somewhat excessively drained to excessively drained. The surface layer is loamy fine sand. Beneath this layer is a transitional layer of loamy fine sand or fine sand. The underlying material is fine sand.

Available water capacity is low. Organic-matter content is moderately low, and permeability is rapid. Runoff is slow. These soils absorb moisture easily and release it readily to plants. They are droughty and are slightly acid. Soil blowing is the principal hazard.

These soils are suited to most crops commonly grown in the county. Where adequate moisture is available, crops respond well if adequate fertilizer is applied. The year before alfalfa is to be planted, lime may need to be added to neutralize the acidity; the amount of lime needed should be determined by soil tests.

Stripcropping and mulch tillage conserve moisture and help to control soil blowing. Field windbreaks and the use of green manure and cover crops, such as rye and vetch, also aid in controlling soil blowing.

CAPABILITY UNIT IIIe-8

This unit consists of deep, well-drained, moderately sloping, eroded soils on loess uplands. The surface layer and the subsoil are silty clay loam, and the underlying material is silty clay loam or silt loam.

Available water capacity is high. Organic-matter content is low or moderately low, and permeability is moderate or moderately slow. Runoff is rapid. These soils have good workability. They absorb moisture easily and release it readily to plants. Erosion is the principal hazard. Controlling and conserving water are important concerns of management. Because these soils are low in nitrogen, fertility needs to be improved and then maintained.

Soils in this unit are suited to most crops commonly grown in the county. They are highly erodible where soybeans are grown. They are well suited to pasture. Growing cool-season grasses in one area and warm-season grasses in another can provide a long green-grazing season for livestock. Cool-season grasses respond well to nitrogen and phosphorus.

Growing soil-building crops such as grasses and legumes and returning crop residue to the soil help to restore the structure and improve the organic-matter content of these soils. Contour farming, terracing, mulch tillage, and grassed waterways and field borders help to prevent erosion, conserve moisture, restore fertility, and control runoff.

CAPABILITY UNIT IIIw-1

Zook silty clay, 0 to 2 percent slopes, is the only soil in this unit. It is a deep, nearly level, somewhat poorly drained soil on bottom lands and is silty clay throughout the profile.

Available water capacity and organic-matter content are high, and permeability is slow. The surface layer is slightly acid to neutral. Runoff is very slow. Overflow from streams and runoff from adjacent soils at higher elevations cause some areas to be ponded for short periods. This soil absorbs moisture slowly and releases it slowly to plants. It is sticky when wet and very hard when dry. Tilling should be done when the surface layer has the proper moisture content. Wetness is the principal hazard.

This soil is suited to many of the crops commonly grown in the county. Wheat, rye, and other small grains that are planted in the fall are better suited than crops that are planted in the spring, when wetness can delay early tillage and planting. Wetness restricts root growth by replacing air in the soil with excess water. Upon drying, the soil cracks and the cracking can damage plant roots. Crop production is limited in some years by the excess water. In areas where adequate drainage outlets are not available, this soil is better suited to hay or to pasture grasses than to other crops.

Surface drainage on this soil can be improved by land shaping. Tile drains or open ditches can be used to lower the water table where suitable outlets are available. Plowing in the fall, when moisture conditions are likely to be favorable, allows this soil to mellow into better tilth over winter. Soil blowing can be controlled by leaving strips of unplowed areas in the field. Growing legumes, such as alfalfa, tends to increase the permeability of this soil. During wet periods, soil compaction can be reduced by not allowing livestock to graze and by avoiding the use of heavy machinery.

CAPABILITY UNIT IIIw-4

Boel loam, 0 to 2 percent slopes, is the only soil in this unit. It is a deep, nearly level, somewhat poorly drained soil on bottom lands of the Elkhorn River valley. The surface layer and the transitional layer beneath the surface layer of this soil are loam. The underlying material is predominantly fine sand but is commonly stratified with thin layers of silt loam.

Available water capacity and the organic-matter content are moderate, and permeability is rapid. The surface layer and the transitional layer are mildly alkaline, and the underlying material is mildly alkaline or neutral. Runoff is very slow. The water table is at a depth of 2 to 6 feet. This soil is subject to flooding from the major streams. It absorbs moisture easily and releases it readily to plants. Wetness is the principal concern of management.

Most of the acreage of this soil is in native grasses and trees. Only a few areas have been cleared. This soil is well suited to hay and pasture grasses that tolerate wetness. It also is suited to most of the crops commonly grown in the county. Wheat and other crops that are planted in the fall are better suited than crops that are planted early in spring, when excessive wetness can delay early tillage and planting. Grain sorghum and soybeans, however, can be grown successfully.

Where suitable outlets are available, drainage ditches can be dug or tile drains can be laid to remove excess water and to lower the water table.

CAPABILITY UNIT IVe-1

Nora silty clay loam, 11 to 15 percent slopes, is the only soil in this unit. This is a deep, well-drained soil on uplands. It is moderately steep and is slightly eroded. The surface layer and subsoil are silty clay loam, and the underlying material is silt loam.

Available water capacity is high, and the organic-matter content and permeability are moderate. Runoff is rapid. This soil is easily tilled. It absorbs moisture easily and releases it readily to plants. Where this soil is cultivated, water erosion is the principal hazard.

This soil is well suited to permanent grass and hay and is used mostly as range or pasture. Growing cool-season grasses in one area and warm-season grasses in another can provide a long green-grazing period for livestock. Cool-season grasses need to be fertilized to promote good growth. Because of the moderately steep slope and the hazard of erosion, this soil is marginal for row crops. Cover crops can be grown, but only small areas are cultivated. Soybeans and other row crops are not well suited. Legumes other than soybeans should be grown 80 percent of the time.

Where this soil is cultivated, contour farming, terracing, stripcropping, and much tillage reduce runoff and increase the intake of water. Grassed waterways and turnrows also aid in controlling water erosion. Leaving crop residue on the soil and adding manure help to control erosion, to maintain fertility, and to improve tilth.

CAPABILITY UNIT IVe-3

Leisy fine sandy loam, 6 to 9 percent slopes, is the only soil in this unit. It is a deep, well-drained, moderately sloping soil on uplands. The surface layer is fine sandy loam. The subsoil is loam in the upper part and silty clay loam below.

Available water capacity is high. Organic-matter content is moderate, and permeability is moderately slow. Runoff is rapid. This soil has good workability. It absorbs moisture easily and releases it readily to plants. Soil blowing and water erosion during heavy rains are the principal hazards.

This soil is suited to most crops commonly grown in the county but is better suited to pasture grasses and hay than to cultivated crops.

Maintaining cover crops and leaving crop residue on the surface of the soil help to prevent soil blowing. Where feasible, terraces, grassed waterways, and contour farming reduce runoff. Stripcropping and mulch tillage help to control soil blowing and water erosion.

CAPABILITY UNIT IVe-5

This unit consists of deep, nearly level to gently sloping, sandy soils on bottom lands and uplands. These soils are well drained or excessively drained. They have a loamy fine sand surface layer. Beneath this layer is a transitional layer of loamy fine sand or fine sand. The texture of the underlying material ranges from loamy fine sand to fine sand.

Available water capacity of soils in this unit is low. Organic-matter content is moderately low or low, and permeability is rapid. Runoff is medium. These soils absorb moisture easily and release it readily to plants. Soil blowing, droughtiness, and the leaching of plant nutrients are the principal hazards where these soils are cultivated. Maintaining fertility is an important concern of management.

These soils are well suited to range and pasture but are marginal for cultivated crops. Alfalfa, grass, small grain, and other close-growing crops can be successfully grown. These crops make their best growth early in spring when rainfall is greater and soil blowing is less severe than later in the planting season. Row crops should be planted only where the soil is covered by crop residue. Rye and hairy vetch, for example, could be interplanted in the fall to provide abundant residue so that a row crop could be planted in the spring.

Strip farming, mulch tillage, and leaving crop residue on the surface of the soil help to control soil blowing and to improve fertility. Narrow plantings of trees that act as windbreaks also reduce soil blowing. The addition of commercial fertilizer helps to maintain fertility.

CAPABILITY UNIT IVe-8

Nora silty clay loam, 11 to 15 percent slopes, eroded, is the only soil in this unit. It is a deep, well-drained, moderately steep soil on uplands. The surface layer and subsoil are silty clay loam, and the underlying material is silt loam.

Available water capacity of this soil is high. Organic-matter content is moderately low, and permeability is moderate. Runoff is rapid. This soil is easily and deeply penetrated by roots. Under good management, it absorbs water easily and releases it readily to plants. It is highly susceptible to sheet, rill, and gully erosion.

This soil is well suited to pasture grasses, range, and hay. Growing cool-season grasses in one area and warm-season grasses in another provides a long green-grazing season for livestock. Although cool-season grasses respond well to nitrogen, warm-season grasses generally do not need fertilizer. Except for soybeans, most crops common to the county can be grown on this soil. Cover crops are better suited than row crops, which should be grown infrequently.

Vegetation or crop residue should be kept on this soil to reduce erosion. Contour farming, terracing, and grassed waterways, turnrows, and field boundaries help to control runoff and to conserve moisture.

CAPABILITY UNIT IVe-9

This unit consists of deep, well-drained soils on uplands. These soils are moderately sloping to moderately steep, are eroded, and have a thin surface layer. They are silt loam throughout the profile.

Available water capacity is high. Organic-matter content is low, and permeability is moderate. Runoff is rapid. These soils release moisture readily to plants. They are subject to severe sheet, rill, and gully erosion. They are moderately alkaline and are low in nitrogen. Fertility needs to be improved and maintained.

Soils in this unit are well suited to pasture grasses and hay. Their use for cultivation is marginal. Soybeans should not be grown, and other row crops should be grown infrequently. The cropping system should include mostly cover crops. Some of these soils are planted to grasses and trees.

Excessive tillage should be avoided. Contour farming, terracing, and grassed waterways, turnrows, and field borders help to conserve moisture and to control water erosion. Leaving crop residue on the surface of the soil and mulch tillage also reduce erosion and improve the organic-matter content. Adding commercial fertilizer, especially nitrogen, improves fertility.

CAPABILITY UNIT IVs-1

Lamo-Slickspots complex, 0 to 2 percent slopes, is the only mapping unit in this capability unit. This complex consists of deep, nearly level, somewhat poorly drained soils on bottom lands. The surface layer and the transitional layer beneath the surface layer are silty clay loam. The underlying material ranges from silty clay to very fine sandy loam. The Lamo soil is strongly alkaline, and Slickspots are very strongly alkaline.

The available water capacity and organic-matter content are high in the Lamo part of the complex and low in the Slickspots part. Permeability is moderately slow or slow. Runoff is slow and ponding commonly occurs in many places. These soils have poor workability. They absorb moisture slowly and release it slowly to plants. Wetness is a hazard during early spring. Both poor surface drainage and slow internal drainage are concerns of management. The strong to very strong alkalinity of the complex is a limitation.

Where wetness can be controlled, these soils are suited to crops and grasses that are tolerant of alkalinity. Suited crops include small grains, such as wheat, that can be planted in the fall; suited grasses include tall fescue and tall wheatgrass, which can be used for pasture or hay. This complex also can be used for native grasses that provide range for livestock and habitat for wildlife.

Where suitable outlets are available, open drains or tile drainage systems help to lower the water table in this complex. Adding large amounts of organic matter such as barnyard manure or leaving crop residue on the surface of these soils can increase the permeability and improve the fertility.

CAPABILITY UNIT Vw-7

This unit consists of deep, nearly level, somewhat poorly drained soils on bottom lands. These soils formed in alluvial material. The surface layer and the transitional layer beneath the surface layer are silty clay loam. The underlying material is silty clay loam and very fine sandy loam.

Available water capacity and the organic-matter content are high. Permeability is moderately slow. Runoff is very slow, and ponding is likely to occur in many places. The water table is at a depth of 0 to 3 feet during most of the year. These soils have poor workability. Wetness is the principal hazard.

These soils are too wet for most cultivated crops. In most places, suitable outlets are not available for drainage, because the soils are in former stream channels that are generally lower than the surrounding soils. The dominant vegetation in these areas consists of tall sedges, prairie cordgrass, willows, and reeds. Such areas are well suited to wetland wildlife.

CAPABILITY UNIT VIe-5

This unit consists of deep, gently sloping to moderately sloping, sandy soils on bottom lands and uplands. These soils are somewhat excessively drained or excessively drained. The surface layer is loamy fine sand. Beneath this layer is a transitional layer of loamy fine sand and fine sand. The underlying material is fine sand.

Available water capacity is low. The organic-matter content is moderately low or low, and permeability is rapid. Runoff is medium. These soils absorb moisture

Figure 13.—**The soil in the background is Crofton silt loam, 15 to 30 percent slopes. Grasses and trees are well suited to this soil.**

easily and release it readily to plants. They are droughty during years of below-normal precipitation. Where they are cultivated, they are susceptible to severe soil blowing. Water erosion is a hazard on the steeper slopes.

These soils are better suited to grasses and trees than to cultivated crops. Areas now cultivated can be planted to warm-season native grasses and can be used for range or pasture. Soils in this unit provide habitat for wildlife.

CAPABILITY UNIT VIe-9

Crofton silt loam, 15 to 30 percent slopes, is the only soil in this unit. It is a deep, well-drained, silty soil on uplands. This soil is steep, is slightly to moderately eroded, and has a thin surface layer. The profile is silt loam throughout.

Available water capacity is high, the organic-matter content is moderately low, and permeability is moderate. Runoff is very rapid. This soil absorbs moisture easily and releases it readily to plants. Water erosion forms gullies and is the principal hazard.

This soil is well suited to grasses and trees (fig. 13). It is too steep for cultivated crops, although small areas have been cultivated. It is used mostly for range, and it provides habitat for wildlife.

CAPABILITY UNIT VIw-7

This unit consists of nearly level, very poorly drained soils on bottom lands. These soils range from loamy fine sand to silty clay loam.

The characteristics of these soils vary widely. Available water capacity and the organic-matter content range from high to low, and permeability ranges from rapid to moderately slow. Runoff is slow or very slow. These soils are flooded several times a year. Wetness is the principal hazard.

Areas are not suited to cultivation because of frequent ponding. They provide habitat for wetland wildlife and can be used for recreational activities such as hunting.

CAPABILITY UNIT VIIIw-7

Only Marsh is in this unit. It consists of nearly level, very poorly drained soil material in depressional areas and in former channels of the Elkhorn River. The surface layer ranges from silt to clay, and the underlying material is silt loam.

Available water capacity and permeability of Marsh are too variable to rate. The organic-matter content is high. Runoff is very slow. Marsh is subject to frequent flooding, and many areas are ponded throughout the year. The water table generally is less than 2 feet below the surface. Wetness is the principal hazard.

Marsh is not suited to cultivation, because most of the areas are subject to frequent ponding. Native vegetation consists of willow, cottonwood, annual weeds, common reedgrass, cattails, tall sedges, rushes, and brush (fig. 14). Marsh provides excellent habitat for wetland wildlife and can be used for recreational areas.

Predicted yields

The predicted acre yields for the principal crops

Figure 14.—An area of Marsh. Cattails, sedges, and water make this area well suited to habitat for wetland wildlife.

grown on soils of Cuming County are given in table 2. These predictions are based on average yields during the period 1967-72 and do not represent yields that might be obtained in later years under new technology.

Yields for various crops were determined from yield records and other pertinent information obtained by interviewing farmers, supervisors of Soil and Water Conservation Districts, representatives of the Soil Conservation Service and Agricultural Extension Service, and others familiar with the soils and farming in the county. Information from the Agriculture Stabilization and Conservation Service and research data from agricultural experiment stations also were used.

Crop production is influenced by many factors. Soil features such as depth, texture, slope, and drainage strongly affect crop yields. Erodibility, available water capacity, permeability, and fertility also are important. Additional factors affecting yields are the cropping pattern, timeliness of operations, plant population, crop variety, and daily, seasonal, and annual fluctuations in the weather.

The yields given in table 2 are those expected under a high level of management as practiced by the best farmers in the county; they do not apply to specific farms or farmers. Under this management, the soil is protected from deterioration and is used in accordance with its capacity. Fertility is maintained, and fertilizer or lime is applied at rates indicated by soil tests and field experiments. Crop residue is returned to the soil to improve tilth and to maintain or increase the organic-matter content of the soil. Adapted varieties of seed are used, and plant populations are optimum. Weeds, insects, and diseases are controlled effectively. Where soils are irrigated, water is applied only when needed and in proper amounts. Water erosion and soil blowing are controlled, and wet soils are drained. Tillage, seeding, and cultivation practices are timely and are adequate.

The results in table 2 can be best used to compare the productivity of one soil with another. Owing to the effects of weather, sudden infestations of insects, disease, or other unpredictable hazards, yields in any one year on a particular soil can vary considerably from the figures given. Improved technology in the future may make predictions in table 2 obsolete; the yield data should be updated when improved methods significantly increase production.

Use of the Soils for Range[3]

The acreage of range (land in native grasses) in Cuming County is very small and is mostly on the sandy soils in the west-central part of the county. These soils generally are not suitable for cultivation, and those that have been cultivated can be reseeded to native grasses.

The success of a range program depends upon the way that the livestock farmer manages his grass and feed reserves. The livestock farmer who has rangeland should know that different kinds of soil produce different kinds and amounts of native grass. To manage his range properly, he needs to know which soils, or range sites, are in his holdings and the plants that

[3] By PETER N. JENSEN, range conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average annual yields per acre of principal crops*

[Yields are for a high level of dryland management. Dashed lines indicate the crop is not suited to the soil or is grown only in very small amounts]

Mapping unit	Corn	Oats	Alfalfa hay	Soybeans	Tame pasture
	Bushels	*Bushels*	*Tons*	*Bushels*	*AUM* [1]
Belfore silty clay loam, 0 to 2 percent slopes	95	70	4.5	40	5.0
Belfore silty clay loam, terrace, 0 to 2 percent slopes	95	70	4.5	40	5.0
Boel loam, 0 to 2 percent slopes	60	45	3.0	30	4.0
Calco silty clay loam, 0 to 2 percent slopes	95	55	4.5	38	5.0
Calco silty clay loam, wet, 0 to 2 percent slopes	---	---	---	---	3.5
Cass fine sandy loam, 0 to 2 percent slopes	80	45	3.8	30	4.0
Colo silty clay loam, 0 to 2 percent slopes	95	54	4.5	34	5.0
Crofton silt loam, 6 to 11 percent slopes, eroded	65	40	2.8	24	2.5
Crofton silt loam, 11 to 15 percent slopes, eroded	55	35	2.2	---	2.0
Crofton silt loam, 15 to 30 percent slopes	---	---	---	---	2.0
Inavale loamy fine sand, 0 to 2 percent slopes	60	38	2.5	20	2.5
Inavale loamy fine sand, 2 to 6 percent slopes	---	---	---	---	2.0
Judson silty clay loam, 2 to 6 percent slopes	100	65	4.5	38	5.0
Kennebec silt loam, 0 to 2 percent slopes	110	70	4.5	42	5.0
Kennebec silt loam, overwash, 0 to 2 percent slopes	100	60	4.4	36	5.0
Lamo silty clay loam, 0 to 2 percent slopes	90	50	4.2	32	5.0
Lamo silty clay loam, wet, 0 to 1 percent slopes	---	---	---	---	3.5
Lamo-Slickspots complex, 0 to 2 percent slopes	65	48	2.7	22	3.5
Leisy fine sandy loam, 2 to 6 percent slopes	80	56	4.2	32	4.5
Leisy fine sandy loam, 6 to 9 percent slopes	74	52	3.8	28	4.2
Leisy loam, 2 to 6 percent slopes	95	58	4.2	36	4.5
Leshara silt loam, 0 to 2 percent slopes	100	68	4.5	35	5.0
Marsh	---	---	---	---	---
Moody silty clay loam, 2 to 6 percent slopes	90	60	4.4	36	4.9
Moody silty clay loam, 2 to 6 percent slopes, eroded	88	53	4.0	31	4.8
Moody silty clay loam, 6 to 11 percent slopes	85	55	3.5	33	4.5
Moody silty clay loam, 6 to 11 percent slopes, eroded	80	45	3.2	28	4.0
Nora silty clay loam, 6 to 11 percent slopes	70	50	3.2	30	4.0
Nora silty clay loam, 6 to 11 percent slopes, eroded	68	47	3.0	27	3.8
Nora silty clay loam, 11 to 15 percent slopes	65	45	2.8	---	3.2
Nora silty clay loam, 11 to 15 percent slopes, eroded	60	40	2.5	---	3.0
Sandy alluvial land	---	---	---	---	1.5
Silty alluvial land	---	---	---	---	1.5
Thurman and Valentine loamy fine sands, 0 to 3 percent slopes	55	40	2.3	22	2.0
Thurman and Valentine loamy fine sands, 3 to 6 percent slopes	50	36	2.0	20	1.5
Thurman and Valentine loamy fine sands, 6 to 11 percent slopes	---	---	---	---	---
Valentine loamy fine sand, 3 to 10 percent slopes	---	---	---	---	---
Wann loam, 0 to 2 percent slopes	90	55	4.0	35	4.5
Zook silty clay loam, 0 to 2 percent slopes	95	45	4.0	32	4.5
Zook silty clay, 0 to 2 percent slopes	85	40	3.8	30	4.5

[1] Animal-unit-month is a term used to express the carrying capacity of pasture. It is the number of animal units, or 1,000 pounds of live weight, that can be grazed on an acre of pasture for 30 days without harm to the pasture.

can grow on each. Management practices that will favor the growth of the best forage plants on each site then can be used. Range condition generally can be improved by reseeding native grasses or introducing new strains. Optimum forage composition can be maintained by proper grazing and deferred grazing practices.

Information concerning the range sites in Cuming County and technical help to determine the best seeding program and management practices for each site can be obtained from the local office of the Soil Conservation Service.

Use of the Soils for Woodland and Windbreaks [4]

Most of the native woodland in Cuming County is limited to the steep Crofton soils adjacent to the Elkhorn River valley and to relatively narrow strips along the Elkhorn River and its tributaries. Woodland on the upper slopes and crests of the hills is made up of scrubby bur oak and sumac. On the lower slopes and in the draws, it consists of American elm, green ash, boxelder, hackberry, basswood, and black walnut. Eastern cottonwood, elm, willow, and other trees that can tolerate wetness grow on the bottom lands.

Native trees and shrubs contribute much to the natural beauty and landscape of the county. They protect the watershed from erosion and provide food and cover for wildlife. Much of the wooded area is capable of producing wood in quantities for commercial use. The potential for the growth of trees is greater on the bottom lands than on drier, steeper slopes, but the commercial value of the wood is much less.

Early settlers in Cuming County planted trees for protection from wind, for shade, and to provide a source of fenceposts. Owing to the scarcity of native trees and to occasional extreme weather, landowners have continued to plant trees in windbreaks to protect

[4] By JAMES W. CARR, JR., forester, Soil Conservation Service.

TABLE 3.—*Suitability of selected trees and shrubs for*

[Estimated heights not given for

Tree and shrub species	Windbreak suitability group					
	1		2		3	
	Suitability	Height	Suitability	Height	Suitability	Height
		Feet		*Feet*		*Feet*
Conifers:						
Austrian pine	Good	33	Fair	26	Good	32
Black hills spruce	Good	28	Fair	24	Fair	25
Colorado blue spruce	Good	29	Poor		Fair	25
Eastern redcedar	Good	26	Good	23	Good	23
Eastern white pine	Good	32	Poor		Fair	28
Norway spruce	Good	30	Fair	24	Fair	28
Ponderosa pine	Good	33	Poor		Good	32
Scotch pine	Good	33	Fair	26	Good	32
Broadleaf trees:						
Black walnut	Good	30	Poor		Poor	
Boxelder	Good	24	Good	20	Poor	
Bur oak	Good	28	Poor		Fair	24
Eastern cottonwood	Fair	60	Fair	55	Fair	55
Golden willow	Fair	32	Good	35	Poor	
Green ash	Good	30	Fair	26	Fair	28
Hackberry	Good	30	Fair	26	Fair	26
Honeylocust	Good	35	Fair	35	Fair	31
Northern red oak	Good	26	Poor		Poor	
Pin oak	Fair	28	Fair	26	Poor	
Russian mulberry	Good	26	Fair	16	Fair	21
Russian-olive	Fair	24	Poor		Fair	18
Silver maple	Good	30	Good	28	Fair	26
Sycamore	Good	38	Good	34	Fair	28
White willow	Fair	32	Good	35	Poor	
Shrubs:						
American plum	Good	10	Good	8	Good	7
Amur maple	Good	12	Fair	8	Fair	8
Autumn-olive	Good	12	Fair	8	Fair	8
Buffaloberry	Fair	10	Good	8	Fair	6
Chokecherry	Good	14	Fair	9	Fair	10
Cotoneaster	Good	8	Fair	5	Fair	6
Honeysuckle	Good	10	Fair	6	Good	8
Lilac	Good	10	Fair	8	Fair	7
Red-osier dogwood	Good	8	Good	8	Poor	
Skunkbush sumac	Good	10	Poor		Good	8

[1] Suitability ratings and estimated heights are not given for Group 10, because soils of that group generally are not suited to windbreaks.

their buildings and livestock. If suitably located, windbreaks contribute to human comfort, reduce home heating costs, help to control snow drifting, reduce erosion, provide shelter for livestock, improve conditions for wildlife, and beautify homesites and countryside. Field windbreaks are used to reduce soil blowing in cropland areas, especially on the sandy Thurman soils and the loamy Leisy soils. In urban areas, windbreaks or screen plantings are used to reduce windspeed, to settle the dust, and to reduce the noise level.

In some years trees are not easily established in Cuming County, but the observance of basic rules of tree culture can result in a high degree of tree survival. A good windbreak consists of trees and shrubs suited to the soils in which they are to grow. Healthy seedlings of adapted species, properly planted in a well-prepared soil and carefully tended after planting, can survive and grow well. Specific information on the design, establishment, and maintenance of windbreaks is available from the Soil Conservation Service.

Growth of trees in windbreaks

The rate of tree growth in a windbreak depends upon the soil and kinds of trees planted. Fertility, available water capacity, and direction and steepness of slope are soil properties that affect the growth rate. Spacing and arrangement of species within the windbreak also are important factors. Some kinds of trees, especially Eastern cottonwood, grow fast but tend to die young. Siberian elm and Russian-olive also grow rapidly and often are short lived; furthermore, they are likely to spread where not wanted. Boxelder and Russian mulberry commonly freeze back in severe winters. Green ash is susceptible to damage by borers.

The trees that are well suited to windbreaks in Cuming County are eastern redcedar, ponderosa pine, Austrian pine, and Scotch pine. These trees are high in survival and vigor, compared with other kinds of trees. Because they hold their needles through the winter, they give maximum protection when it is most *windbreaks and estimated height attained in 20 years* [1]

species having poor suitability rating]

Windbreak suitability group—Continued							
4		5		6		7	
Suitability	Height	Suitability	Height	Suitability	Height	Suitability	Height
	Feet		*Feet*		*Feet*		*Feet*
Good	28	Fair	26	Poor		Fair	24
Poor		Poor		Poor		Poor	
Fair	24	Poor		Poor		Poor	
Good	24	Good	20	Poor		Good	18
Fair	26	Poor		Poor		Poor	
Fair	25	Poor		Poor		Poor	
Good	28	Good	27	Poor		Good	26
Good	28	Fair	26	Poor		Fair	24
Poor		Poor		Poor		Poor	
Poor		Poor		Poor		Poor	
Good	24	Good	20	Poor		Poor	
Poor		Poor		Fair	45	Fair	40
Poor		Poor		Good	24	Poor	
Good	26	Poor		Poor		Poor	
Good	26	Poor		Poor		Poor	
Fair	30	Poor		Poor		Poor	
Fair	22	Poor		Poor		Poor	
Poor		Poor		Poor		Poor	
Good	24	Poor		Poor		Poor	
Fair	21	Fair	16	Poor		Poor	
Fair	25	Poor		Poor		Poor	
Poor		Poor		Poor		Poor	
Poor		Poor		Good	24	Poor	
Good	8	Fair	6	Poor		Fair	4
Fair	10	Poor		Poor		Poor	
Fair	10	Poor		Poor		Poor	
Poor		Poor		Fair	6	Poor	
Good	10	Poor		Poor		Poor	
Good	6	Poor		Poor		Poor	
Good	7	Fair	5	Poor		Poor	
Good	7	Fair	5	Poor		Poor	
Poor		Poor		Fair	6	Poor	
Good	8	Good	6	Poor		Poor	

needed. Eastern redcedar can reach a height of 30 to 40 feet at maturity. Pines and adapted broadleaf trees grow slightly faster and are somewhat taller at maturity. Broadleaf trees that are well suited to windbreaks in the county are boxelder, bur oak, green ash, hackberry, Russian mulberry, silver maple, sycamore, and willow. Shrubs that are well suited are American plum, common chokecherry, cotoneaster, honeysuckle, lilac, red-osier dogwood, and skunkbush sumac.

Table 3 gives the relative vigor and estimated height at 20 years of age for several kinds of trees that commonly are planted on soils of the principal windbreak suitability groups. Ratings for vigor are based upon observations of the relative vigor and general condition of the trees. A rating of *good* indicates that leaves (or needles) are normal in color and growth, that only small amounts of deadwood occur within the live crowns of the trees, and that damage because of disease, insects, and climate is small. *Fair* indicates either that leaves (or needles) are somewhat abnormal in color and growth, that substantial amounts of deadwood occur within the live crowns, that damage because of disease, insects, or climate is moderate, or that the current year's growth is obviously less than normal. *Poor* indicates either that leaves (or needles) are very abnormal in color and growth, that very large amounts of deadwood occur within the live crowns, that damage because of disease, insects, or climate is extensive, or that the current year's growth is almost negligible. Estimated heights are based on detailed measurements made by forestry technicians on most kinds of trees and shrubs in windbreaks that were approximately 20 years old.

Windbreak suitability groups

The soils of Nebraska are classified into windbreak suitability groups according to characteristics that affect tree growth. Soils in any one group produce similar growth of equal survival capacity under normal weather conditions and with proper care. To find the names of all the soils in any group, reference should be made to the "Guide to Mapping Units" at the back of this survey. Each of the windbreak suitability groups is described in the following pages.

WINDBREAK SUITABILITY GROUP 1

This group consists of deep, nearly level, well-drained and moderately well drained soils on stream terraces and on bottom lands adjacent to upland streams and drainageways. Silt deposited during floods occurs in some areas. The surface layer and underlying material of soils in this group are silt loam or silty clay loam. Some soils have a subsoil of silty clay or silty clay loam, and some have a transitional layer of silt loam below the surface layer. These soils have high available water capacity. Runoff is slow.

These soils provide good planting sites. Windbreaks of adapted trees have a good chance for survival and growth if not subjected to excessive competition from weeds and grasses for the available moisture. Occasional flooding by water received from adjacent soils on higher elevations is a hazard.

WINDBREAK SUITABILITY GROUP 2

This group consists of deep, nearly level soils on bottom lands and low terraces in the major stream valleys. The surface layer of soils in this group is loam, silt loam, silty clay loam, or silty clay. Some soils have a subsoil of silty clay loam or silty clay. Others have a transitional layer of loam, silt loam, or silty clay loam below the surface layer. The underlying material ranges from silty clay to fine sand. These soils are somewhat poorly drained. They have a water table at a depth of 2 to 8 feet, and wetness is a limitation. Available water capacity is moderate to high. Runoff is slow or very slow.

These soils provide good planting sites. Windbreaks have a good chance for growth and survival if the trees are species that tolerate occasional wetness. Establishment of trees can be difficult during wet years. The abundant and persistent herbaceous vegetation competes with the young trees and also makes it difficult to cultivate the soil between the tree rows.

WINDBREAK SUITABILITY GROUP 3

This group consists of deep, nearly level to moderately sloping soils on uplands and bottom lands. The surface layer of the soils is fine sandy loam or loamy fine sand. Some soils have a subsoil of loam or silty clay loam, and some have a transitional layer of loamy fine sand or sandy loam beneath the surface layer. The texture of the underlying material ranges from silty clay loam to fine sand. These soils are well drained to excessively drained and are droughty in years of below-normal rainfall. Available water capacity is low to high. Runoff is slow to rapid.

These soils provide good planting sites. Windbreaks of adapted kinds of trees have a fair chance for survival and growth if not subjected to soil blowing and a lack of adequate moisture. Soil blowing can be controlled by maintaining strips of sod or other vegetation between the tree rows. Only the soil in the tree rows should be cultivated.

WINDBREAK SUITABILITY GROUP 4

This group consists of deep, well-drained soils on uplands and foot slopes. The surface layer is loam or silty clay loam, and the subsoil is silty clay loam, loam, or silty clay. The underlying material is silt loam or silty clay loam. These soils are nearly level to moderately steep, and some are eroded. They have a high available water capacity. Runoff ranges from slow to rapid.

These soils provide good planting sites. Windbreaks of adapted kinds of trees have a good chance for survival and fair growth if not subjected to drought or competition from weeds and grasses for the available moisture. A lack of sufficient moisture, because of rapid runoff, reduces the growth of trees on the steeper slopes. In places water erosion is a hazard if trees are planted on the gently sloping to steep areas.

WINDBREAK SUITABILITY GROUP 5

This group consists of deep, well-drained, moderately sloping to moderately steep soils on uplands. The surface layer and underlying material are silt loam. These soils are eroded and have a thin surface layer. They are calcareous, and the organic-matter content is low. Available water capacity is high, and runoff is rapid.

These soils provide fair to poor planting sites. Windbreaks of adapted kinds of trees have a fair to poor chance for survival and growth. The low fertility and calcareous condition of the soils and the lack of adequate moisture on the moderately steep soils are the principal limitations. Water erosion is a hazard.

WINDBREAK SUITABILITY GROUP 6

This group consists of deep, nearly level soils on bottom lands. The surface layer and subsoil are silty clay loam. Some soils have a transitional layer of silty clay loam beneath the surface layer. The underlying material is silty clay loam or very fine sandy loam. These soils are somewhat poorly drained. They have a water table at a depth of 0 to 3 feet and are flooded occasionally. Available water capacity is high, and runoff is very slow.

These soils generally provide poor planting sites, but the survival and growth of adapted species are fair. Trees for windbreaks are limited to those that are tolerant of a high water table or occasional flooding. Excessive wetness is the principal limitation, and reducing wetness is a concern of management.

WINDBREAK SUITABILITY GROUP 7

This group consists of deep, gently sloping to moderately sloping soils on uplands. The surface layer is loamy fine sand. Beneath this layer is a transitional layer of loamy fine sand or fine sand. The underlying material is fine sand. These soils are somewhat excessively drained to excessively drained and are droughty in years of below-normal rainfall. They have low available water capacity. Runoff is medium.

These soils provide fair planting sites. Windbreaks of adapted kinds of trees have a fair chance for survival and growth. Because the soils are loose, trees should be planted in shallow furrows, and the soils should not be cultivated. In places young seedlings suffer from sandblasting or are covered by drifting sand during high winds.

WINDBREAK SUITABILITY GROUP 10

This group consists of soils and land types that vary widely in soil texture and characteristics. These soils range from silty clay to sand, and they are nearly level or steep, are very poorly drained or well drained, and are neutral to very strongly alkaline. Some are excessively wet, and some are frequently flooded. On others, runoff is very rapid, and the hazard of erosion is severe.

The soils in this group generally are not suited to windbreaks. Some areas can be used to provide habitat for wildlife or for recreation. In places, adapted kinds of trees and shrubs can be grown successfully if they are planted and tended by hand.

Use of the Soils for Wildlife[5]

Cover, food, and water are essential to the production and survival of wildlife. The kinds and number of wildlife that can be produced and maintained in an area are determined largely by the kinds, amount, and distribution of vegetation. The vegetation, in turn, is governed by soil characteristics such as fertility, topography, wetness, permeability, and available water capacity.

Fertile soils generally produce more food and better habitat for wildlife than infertile soils, and water that drains from fertile soils usually produces more fish and other aquatic life. Topography affects wildlife through its influence on how land can be used. Steep slopes and rough, irregular areas are a hazard to livestock and are poorly suited to crop production. Undisturbed vegetation on such land, however, is valuable as a source of food and cover for some kinds of wildlife. Where such cover is lacking, it often can be developed. Wetness, permeability, and available water capacity are important considerations in the construction of ponds for fish and in maintaining wetland habitat for waterfowl.

Soils of Cuming County provide suitable habitat for many species of game and nongame birds and animals. The following discussion pertains primarily to the game species and their habitat, although nongame species are becoming increasingly important.

Suitable habitat for various kinds of wildlife include different types of dryland vegetation, wetland vegetation, and shallow-water sites. *Grain and seed crops* (such as corn, sorghum, wheat, oats, barley, millet, soybeans, sunflowers, and other domestic grains or seed-producing annuals) produce food for wildlife. *Domestic grasses and legumes* (such as fescue, bluegrass, bromegrass, timothy, orchardgrass, clover, alfalfa, trefoil, crownvetch, and other perennial grasses and herbaceous legumes) provide food and cover. *Wild herbaceous plants* (such as bluestem, indiangrass, goldenrod, beggarweed, partridgepea, pokeweed, wheatgrasses, fescues, gramas, or other native or naturally established dryland grasses and forbs, including weeds) supply food and cover. *Hardwood trees and shrubs* (such as cottonwood, willow, ash, boxelder, oak, Russian-olive, snowberry, honeysuckle, and other nonconiferous trees and associated woody understory plants) provide cover and shade and produce nuts, berries, buds, catkins, twigs, bark, or foliage that can be used as food. *Coniferous plants* (such as pine, spruce, fir, cedar, juniper, and other cone-bearing trees, shrubs, or ground cover) furnish cover and supply food in the form of browse, seeds, or fruitlike cones; these plants commonly are established through natural processes, but they can be planted or transplanted. *Wetland food and cover* (such as smartweed, wild millet, rushes, sedges, reeds, cordgrass, cattail, and other annual and perennial wild herbaceous plants that grow on moist or wet sites) are used extensively by wetland forms of wildlife; vegetation in this group does not include submerged or floating aquatics. *Shallow-water areas* include muskrat marshes, waterfowl feeding areas, wildlife watering developments, wildlife ponds, beaver ponds, and other sites where the surface water has an average depth of less than 5 feet; such areas occur as natural marshes or ponds, or they are created by the use of dams, levees, or other water-control devices in marshes or streams.

The various kinds of wildlife can be classified according to habitat. *Openland wildlife* includes bobwhite quail, pheasant, meadowlark, killdeer, cottontail rabbit, red fox, woodchuck, and other birds and mammals that live in croplands, pastures, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, or vines. *Woodland wildlife* includes wild turkey, ruffed grouse, thrushes, vireos, woodpecker, squirrel, gray fox, raccoon, white-tailed deer, and other birds and mammals found in wooded areas containing either hardwood or coniferous trees and shrubs, or a mixture of both. *Wetland wildlife* includes ducks, geese, herons, shore birds, rails, kingfishers, muskrat, mink, beaver, and other birds and mammals indigenous to swampy, marshy, or open-water areas.

Table 4 shows the potential of the principal soils of each soil association in the county for producing different kinds of habitat and their potential for producing different kinds of wildlife. However, soils having the highest potential for producing wildlife generally are not those that have the highest wildlife populations. Farming soils are managed intensively for maximum crop yields rather than for wildlife habitat. Hunting limits the production of some species. The relationship between habitat and wildlife populations in each of the soil associations is discussed in the following paragraphs.

The Nora-Moody-Judson association is dissected by numerous deep drainageways that are not cultivated. The native vegetation in these areas provides food and cover for wildlife. Squirrel, raccoon, opossum, and songbirds are common in wooded areas, especially those near water. Fox and coyote occur in moderate numbers. In the northwestern part of the association, cottontail rabbits are plentiful, numbering 100 to 300 per square mile; in the western part, they are less abundant—about 10 to 100 per square mile. Pheasants have a low population (10 to 50 per square mile), and bobwhite quail are scarce (about 10 per square mile).

The Colo-Calco-Kennebec association is on bottom lands. Most of the acreage is cultivated, and some areas are tile drained. Eastern cottonwood, willow, and other deciduous trees grow along the drainageways.

[5] By ROBERT O. KOERNER, biologist, Soil Conservation Service.

TABLE 4.—*Potential of principal soils for producing elements of wildlife*

Soil association and soil	Potential for producing—			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees and shrubs
Nora-Moody-Judson:				
Nora soils	Fair	Good	Good	Good
Moody soils	Good	Good	Good	Good
Judson soils	Good	Good	Good	Good
Colo-Calco-Kennebec:				
Colo soils	Good	Good	Good	Fair[1]
Calco soils	Good	Good	Good	Fair[1]
Kennebec soils	Good	Good	Good	Good
Moody-Nora-Belfore:				
Moody soils	Good	Good	Good	Good
Nora soils	Fair	Good	Good	Good
Belfore soils	Good	Good	Good	Good
Zook-Leshara-Wann:				
Zook soils	Fair	Good to fair	Fair	Fair
Leshara soils	Good	Good	Good	Good
Wann soils	Good	Good	Good	Fair[1]
Thurman-Leisy-Moody:				
Thurman soils	Fair	Fair	Good	Fair
Leisy soils	Fair	Good	Good	Good
Moody soils	Good	Good	Good	Good

[1] Good for eastern cottonwood and willow.

Crop residue provides food for wildlife that use the vegetation in the drainageways for cover. Squirrel, cottontail rabbit, raccoon, opossum, and songbirds are the primary kinds of wildlife in this area. There are some white-tailed deer. A few fish ponds have been dug in this association.

Most of the soils in the Moody-Nora-Belfore association, which is the largest association in the county, are cultivated. Trees are very scarce, and cover for most kinds of wildlife is not plentiful, especially in winter. Pheasants, quail, and cottontail rabbits inhabit the area, but they are less numerous than in the Nora-Moody-Judson association.

The Zook-Leshara-Wann association is on the bottom land of the Elkhorn River valley. Eastern cottonwood, willow, green ash, boxelder, and oak are the common kinds of trees, and the many wooded areas provide good cover for wildlife. White-tailed deer and other kinds of wildlife are more numerous in this association than elsewhere in Cuming County. Squirrel, raccoon, opossum, and songbirds are common. Bobwhite quail nest in brushy patches. Muskrat and wood duck live in the marshy area known locally as Black Island, which is near the west county line. Some wetland wildlife find habitat in and around gravel pits along the river, and migrating fowl frequent the area along the river in spring and fall.

In the Thurman-Leisy-Moody association, Eastern cottonwood and willow trees grow in the drainageways, and windbreaks of deciduous and coniferous trees have been planted near some farmsteads. These provide cover for some kinds of wildlife. The native grassland provides nesting sites for upland game birds and habitat for rodents, such as ground squirrels and gophers. Quail, pheasant, and cottontail rabbits are also common.

Streams and ponds in Cuming County provide suitable habitat for several kinds of fish. The Elkhorn River and its tributaries are warm-water streams in which are gar, gizzard shad, carp, minnows, suckers, catfish, largemouth bass, black crappie, bluegill, and green sunfish. Approximately 92 acres of privately owned waters have been artificially created in the county. These include farm ponds that generally are stocked with bass, bluegill, and catfish. Sand pits also provide some fishing.

Plans for the optimum use of both rural and urban areas should include wildlife management programs. Conditions for the production and maintenance of wildlife species can be improved with little cost and effort. The lack of cover is the primary factor limiting the amount of wildlife in Cuming County. Cover for wildlife can be improved and increased by excluding livestock from drainageways and waterways, by planting uncultivated areas to woody and herbaceous plants, and by leaving crop residue in the fields. The habitat can also be improved by planting small patches to food for wildlife. Technical assistance for designing and installing measures to improve wildlife habitat is available from the Soil Conservation Service and other State and Federal agencies.

Engineering Uses of the Soils[6]

Information about soils used as structural material or as foundations upon which structures are built is of

[6] SYDNEY H. HAAKENSTAD, engineer, Soil Conservation Service, assisted in preparation of this section.

habitat and for producing habitat suitable for different kinds of wildlife

Potential for producing—Continued			Potential as habitat for—		
Coniferous plants	Wetland food and cover	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Fair	Fair	Fair	Good	Fair	Fair.
Fair	Fair	Fair	Good	Fair	Fair.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Poor	Good	Good	Very poor.
Fair	Fair	Fair	Good	Fair	Fair.
Fair	Fair	Fair	Good	Fair	Fair.
Fair	Fair	Fair	Good	Fair	Fair.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Good	Very poor	Very poor	Good	Fair	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.

special interest to engineers, contractors, planning commissions, town and city managers, land developers, and farmers. Among properties of soils highly important in engineering are permeability, shear strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and slope of the soil. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Estimates of several soil properties significant to engineering and interpretations for various engineering uses are given in tables 5 and 6, respectively, for all soils in Cuming County. Table 7 gives test data for samples of selected layers taken from 11 soil profiles. The estimates and interpretations in these tables can be helpful to those who—

1. Select potential residential, industrial, commercial, or recreational areas;
2. Evaluate alternate routes for roads, highways, pipelines, or underground cables;
3. Seek sources of gravel, sand, or clay;
4. Plan farm drainage systems, irrigation systems, ponds, terraces, or other structures for controlling water and conserving soil;
5. Correlate performance of engineering structures already built with the properties of the soils on which they are built, and then develop information for predicting performance of structures on the same or similar kinds of soils in other locations;
6. Predict the suitability of soils for cross-country movement of vehicles or construction equipment; and
7. Develop preliminary estimates pertinent to construction in a particular area.

The engineering interpretations in this report, used in conjunction with the soil map and other parts of the survey, serve many useful purposes. It should be emphasized, however, that they do not eliminate the need for detailed field investigations at sites for specific engineering works. Sampling and testing are particularly important where construction involves heavy loads or excavations deeper than those shown in the tables, generally about 5 feet. Also, inspection of sites, especially the smaller ones, is needed because delineated areas of many soil mapping units contain small areas of other soils that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have different meanings in soil science than in engineering. These terms are defined in the Glossary as they are used in soil science.

Soil classification systems

The two systems most commonly used in classifying soils for engineering purposes are the Unified system (*7*) and the AASHO system (*1*). The former is used by Soil Conservation Service engineers, the Department of Defense, and others. The latter was developed and adopted by the American Association of State Highway Officials. Estimated classifications of all the soils in Cuming County according to these two systems and according to the textural classification used by the United States Department of Agriculture (USDA) (*4*) are given in table 5.

TABLE 5.—*Estimates of soil*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two kinds of soil. As soils in series, which also appears in the first column. Symbol > means

Soil series and map symbols	Depth of seasonal high water table	Depth from surface	Dominant USDA texture	Classification	
				Unified	AASHO
	Feet	*Inches*			
Belfore: Be, Bf	>10	0–14	Silty clay loam	CL	A-6 or A-7
		14–55	Silty clay or silty clay loam.	CL or CH	A-7
		55–60	Silty clay loam	CL or CH	A-7
Boel: Bo	2–6	0–12	Loam	ML or CL	A-4 or A-6
		12–48	Fine sand	SP-SM or SM	A-2 or A-4
		48–54	Silt loam	ML	A-4 or A-6
		54–60	Fine sand	SP-SM or SM	A-2 or A-4
Calco: Ca, Cb	[3] 2–6	0–60	Silty clay loam	CL or CH	A-7
Cass: Cd	6–10	0–20	Fine sandy loam	SM	A-2 or A-4
		20–54	Very fine sandy loam to loamy fine sand.	SM	A-2
		54–60	Fine sand	SP-SM	A-3
Colo: Ce	3–8	0–34	Silty clay loam	CL or CH	A-7
		34–60	Silty clay loam	CL or CH	A-7
Crofton: CfD2, CfE2, CfF	>10	0–6	Silt loam	CL	A-6 or A-7
		6–60	Silt loam	CL	A-6 or A-7
Inavale: In, InC	6–10	0–5	Loamy fine sand	SM	A-2
		5–15	Loamy fine sand	SM	A-2
		15–60	Fine sand	SP-SM or SM	A-2 or A-3
Judson: JuC	>10	0–60	Silty clay loam	CL, CL-ML, or ML	A-6 or A-7
Kennebec: Ke, Ko	8–12	0–60	Silt loam and light silty clay loam.	CL	A-6 or A-7
Lamo: La, Lb, Lc	[4] 2–8	0–56	Silty clay loam	CL or CH	A-7
Slickspots part of unit Lc is variable; no valid estimates can be made.		56–60	Very fine sandy loam	ML	A-4
Leisy:					
LeC, LeD	>10	0–18	Fine sandy loam	SM	A-4
		18–22	Loam	ML	A-4 or A-6
		22–60	Silty clay loam	CL	A-6 or A-7
LfC	>10	0–20	Loam	ML	A-4 or A-6
		20–60	Silty clay loam	CL	A-6 or A-7
Leshara: Lh	2–8	0–42	Silt loam	ML	A-4 or A-6
		42–60	Sandy loam	SM	A-2
Marsh: Mh					
Material variable; no valid estimates can be made.					
Moody: MoC, MoC2, MoD, MoD2	>10	0–14	Silty clay loam	CL	A-7
		14–46	Silty clay loam	CL or CH	A-7
		46–54	Silty clay loam	CL	A-7
		54–60	Silt loam	CL	A-6 or A-7

properties significant to engineering

these mapping units may have different properties and limitations, it is necessary to follow the instruction to refer to the other "more than"; symbol < means "less than"]

Percentage less than 3 inches passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
			Percent		*Inches per hour*	*Inches per inch of soil*	*pH*	
-------------	100	95–100	35–45	12–20	0.2–0.6	0.21–0.23	5.6–7.3	Moderate.
-------------	100	95–100	45–60	20–30	0.2–0.6	0.15–0.20	6.1–7.3	High.
-------------	100	95–100	41–55	20–30	0.2–0.6	0.18–0.20	6.6–7.8	High.
-------------	100	51–70	20–40	<15	0.6–2.0	0.20–0.22	6.6–8.4	Low.
100	85–95	8–25	[1] NP	NP	6.0–20	0.05–0.07	6.6–8.4	Low.
100	95–100	60–90	20–40	<15	0.6–2.0	0.20–0.22	7.4–7.8	Low.
100	85–95	8–25	NP	NP	6.0–20	0.05–0.07	6.6–7.3	Low.
-------------	100	85–100	41–60	20–35	0.2–0.6	0.18–0.23	7.4–9.0	High.
[3] 98–100	85–95	20–40	NP	NP	2.0–6.0	0.16–0.18	5.6–7.3	Low.
[3] 98–100	85–95	15–35	NP	NP	2.0–6.0	0.08–0.14	5.6–7.3	Low.
100	70–85	5–10	NP	NP	6.0–20	0.05–0.07	5.6–7.3	Low.
-------------	100	95–100	41–55	15–30	0.2–0.6	0.21–0.23	5.6–7.3	High.
-------------	100	95–100	41–55	20–30	0.2–0.6	0.18–0.20	5.6–7.3	High.
-------------	100	95–100	35–45	15–25	0.6–2.0	0.22–0.24	7.4–8.4	Moderate.
-------------	100	95–100	35–45	15–25	0.6–2.0	0.20–0.22	7.4–8.4	Moderate.
100	85–95	15–35	NP	NP	6.0–20	0.10–0.12	6.1–7.3	Low.
100	70–85	15–35	NP	NP	6.0–20	0.10–0.12	6.1–7.3	Low.
100	70–90	5–20	NP	NP	6.0–20	0.05–0.07	6.1–7.3	Low.
-------------	100	95–100	35–50	11–25	0.6–2.0	0.18–0.23	6.1–7.3	Moderate.
-------------	100	95–100	35–50	15–25	0.6–2.0	0.20–0.24	6.1–7.3	Moderate.
-------------	100	95–100	40–60	20–35	0.2–0.6	0.18–0.23	7.4–9.0	High.
100	85–95	51–65	20–35	<10	0.6–2.0	0.17–0.19	7.4–8.4	Low.
100	70–85	40–50	NP	NP	2.0–6.0	0.16–0.18	6.1–6.5	Low.
100	85–95	60–75	20–40	<15	0.6–2.0	0.17–0.19	6.1–6.5	Low.
100	95–100	85–90	35–50	15–30	0.2–0.6	0.18–0.20	6.1–7.3	Moderate.
100	85–95	60–75	20–40	<15	0.6–2.0	0.20–0.22	6.1–6.5	Low.
100	95–100	85–90	35–50	15–30	0.2–0.6	0.20–0.22	6.1–7.3	Moderate.
100	95–100	60–90	20–40	<15	0.6–2.0	0.22–0.24	7.4–8.4	Low.
100	70–85	20–35	NP	NP	2.0–6.0	0.11–0.13	7.4–8.4	Low.
-------------	100	95–100	41–50	15–25	0.2–0.6	0.21–0.23	6.1–7.3	Moderate.
-------------	100	95–100	41–55	20–30	0.2–0.6	0.18–0.20	6.1–7.3	High.
-------------	100	95–100	41–50	15–25	0.2–0.6	0.18–0.20	7.4–9.0	Moderate.
-------------	100	95–100	30–50	10–25	0.6–2.0	0.20–0.22	8.5–9.0	Moderate.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Dominant USDA texture	Classification	
				Unified	AASHO
	Feet	*Inches*			
Nora: NoD, NoD2, NoE, NoE2	>10	0–12 12–39 39–60	Silty clay loam Silty clay loam Silt loam	CL CL or CH CL	A–6 or A–7 A–6 or A–7 A–6 or A–7
Sandy alluvial land: Sa. Material variable; no valid estimates can be made.					
Silty alluvial land: Sy. Material variable; no valid estimates can be made.					
Slickspots. Mapped only in complex with Lamo soils. Material variable; no valid estimates can be made.					
*Thurman: TvB, TvC, TvD. For Valentine parts of these units, see Valentine series.	>10	0–19 19–60	Loamy fine sand Fine sand	SM or SP–SM SM or SP–SM	A–2 or A–3 A–2 or A–3
Valentine: VaD	>10	0–5 5–60	Loamy fine sand Fine sand	SM or SP–SM SM or SP–SM	A–2 or A–3 A–2 or A–3
Wann: Wm	3–8	0–12 12–48 48–60	Loam Fine sandy loam Fine sand	ML SM SP–SM	A–4 or A–6 A–2 or A–4 A–3
Zook:					
Zo	3–8	0–19 19–60	Silty clay loam Silty clay	CH or CL CH	A–7 A–7
Zw	3–8	0–60	Silty clay	CH	A–7

[1] NP means nonplastic.
[2] Depth to seasonal high water table is 0–3 feet in unit Cb.

The Unified system is used to classify soils according to their engineering uses for building material or for support of structures other than highways. It is based on the texture, plasticity, and performance of the soils. Each classification consists of two letters that represent the principal characteristics of the soil. The first letter indicates whether the soil is coarse grained, fine grained, or organic (or peat). The coarse-grained soils are gravel, G, and sand, S. These are further classified primarily by gradation: W for well graded and P for poorly graded; for example, SP is a sand, poorly graded. The fine-grained soils are silt, M, and clay, C. These are further classified according to plasticity characteristics: L for low liquid limit and H for high liquid limit; therefore, CL is a clay of low plasticity. Organic soils, O, and peat, Pt, are classified according to odor and to plasticity changes after oven-drying. Soils that have borderline characteristics of two classifications are given a dual classification. Tables 5 and 7 show that the soils of Cuming County are classified as SW–SM, SP–SM, SM, MH–CH, ML, ML–CL, CL, and CH.

The AASHO system is used to classify soils according to those properties that affect their use in highway construction and maintenance. It is based on the field performance of the soil. In this system soil materials are placed in one of seven groups, ranging from A–1 (soils that have high bearing capacity) to A–7 (soils that have low bearing capacity when wet). Soils that are classified A–1, A–2, or A–3 are predominantly sand or gravel or a mixture of sand and gravel. Soils classified A–4 through A–7 are mostly silt and clay mixtures. A sand-silt-clay soil is further classified by identifying the silt-clay portion. Thus, an A–2–4 soil is an A–2 sand that has an A–4 type of silt-clay mixture included. The relative engineering value of each soil within the group is indicated by a group index number, which is shown in parentheses after the soil group. Group index numbers range from 0 for the best material to 20 for the poorest. Table 7 gives the AASHO classification and group index numbers for selected soils. Table 5 gives estimated AASHO classifications, without group index numbers, for all soils in Cuming County.

Many soil scientists use the USDA textural classi-

significant to engineering—Continued

Percentage less than 3 inches passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
			Percent		*Inches per hour*	*Inches per inch of soil*	*pH*	
-------------	100	95–100	30–50	11–25	0.2–0.6	0.21–0.23	6.6–7.3	Moderate.
-------------	100	95–100	35–55	15–30	0.6–2.0	0.18–0.20	7.4–9.0	Moderate.
-------------	100	95–100	30–50	11–25	0.6–2.0	0.20–0.22	7.4–9.0	Moderate.
100	90–100	8–30	NP	NP	6.0–20	0.10–0.12	6.1–7.3	Low.
100	85–100	5–25	NP	NP	6.0–20	0.09–0.11	6.1–7.3	Low.
100	90–100	8–30	NP	NP	6.0–20	0.10–0.12	6.1–7.3	Low.
100	85–100	5–20	NP	NP	6.0–20	0.09–0.11	6.1–7.3	Low.
100	90–95	51–70	20–40	<15	0.6–2.0	0.20–0.22	6.6–7.8	Moderate.
100	85–90	30–50	<25	<10	2.0–6.0	0.15–0.17	7.4–8.4	Low.
100	85–90	5–10	NP	NP	6.0–20	0.05–0.07	7.4–8.4	Low.
-------------	100	95–100	45–70	20–45	0.2–0.6	0.21–0.23	6.4–7.3	High.
-------------	100	95–100	55–75	30–50	0.06–0.2	0.10–0.12	6.6–7.3	High.
-------------	100	95–100	55–75	30–50	0.06–0.2	0.10–0.12	6.6–7.3	High.

[3] 100 percent of material passed the No. 4 sieve (4.7 mm).
[4] Depth to seasonal high water table is 0–3 feet in unit Lb.

fication. In this system, the texture of the soil material is determined according to the proportion of sand, silt, and clay in the part of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is used in the classification. "Gravelly loamy sand," for example, is sand and a mixture of some clay, silt, and gravel. "Sand," "silt," "clay," and other terms used in the USDA classification are defined in the Glossary at the back of this survey.

Soil properties significant to engineering

Several estimated soil properties significant to engineering are given in table 5. These estimates, listed by soil layers that have significantly different properties, are based on field observations made in the course of mapping, on test data for these and similar soils, and on information available about the same kinds of soil in other counties.

For each soil, table 5 gives the depth to the seasonal high water table—that is, the distance from the surface of the soil to the highest level that ground water reaches during most years. The USDA textural classification and the Unified and AASHO classifications are given for each layer. The depth to bedrock is not given, because no soil in Cuming County has bedrock at a depth of less than 5 feet. Other properties given in table 5 are discussed in the following paragraphs.

The liquid limit and plasticity index are measures of the consistence of a soil. As the moisture content of a clayey soil (a soil containing no particles coarser than 0.42 millimeter) increases from a dry condition, the soil changes from a semisolid to a plastic state. If the moisture content is further increased, the soil changes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material changes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the soil changes 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

TABLE 6.—*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. fully the instructions for referring to other series

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings	Sanitary landfill [1] (area and trench types)	Local roads and streets
Belfore: Be, Bf	Severe: Moderately slow permeability.	Slight	Slight for relatively dry working conditions.	Moderate to severe: high shrink-swell potential; subject to frost action.	Moderate for trench type: too clayey. Slight for area type: fair cover soil; too clayey.	Moderate to severe: subject to frost action; high shrink-swell potential.
Boel: Bo	Severe: water table at a depth of 2 to 6 feet; flooded occasionally; hazard of polluting water supply.	Severe: rapid permeability; flooded occasionally; hazard of polluting water supply.	Severe: somewhat poorly drained; water table at a depth of 2 to 6 feet; flooded occasionally; hazard of caving.	Severe: flooded occasionally; water table at a depth of 2 to 6 feet.	Severe: flooded occasionally; rapid permeability; water table at a depth of 2 to 6 feet; poor cover soil; sand below a depth of 1 to 1.5 feet.	Moderate to severe: subject to frost action; flooded occasionally; water table at a depth of 2 to 6 feet.
Calco:						
Ca	Severe: water table at a depth of 2 to 6 feet; flooded occasionally; moderately slow permeability.	Severe: water table at a depth of 2 to 6 feet; flooded occasionally.	Severe: water table at a depth of 2 to 6 feet; flooded occasionally.	Severe: water table at a depth of 2 to 6 feet; flooded occasionally; high shrink-swell potential.	Severe: flooded occasionally; water table at a depth of 2 to 6 feet.	Severe: seasonal high water table; high shrink-swell potential; flooded occasionally.
Cb	Severe: water table at a depth of 0 to 3 feet; flooded occasionally; moderately slow permeability.	Severe: water table at a depth of 0 to 3 feet; flooded occasionally.	Severe: water table at a depth of 0 to 3 feet; flooded occasionally.	Severe: water table at a depth of 0 to 3 feet; flooded occasionally; high shrink-swell potential.	Severe: flooded occasionally; water table at a depth of 0 to 3 feet.	Severe: water table at a depth of 0 to 3 feet; high shrink-swell potential; flooded occasionally.
Cass: Cd	Slight: hazard of polluting water supply.	Severe: moderately rapid permeability; hazard of polluting water supply.	Severe: poor stability; flooded occasionally; hazard of caving.	Severe: flooded occasionally; hazards of seepage and caving; subject to frost action.	Severe: moderately rapid permeability: water table at a depth of 6 to 10 feet; fair cover soil; hazard of soil blowing.	Slight: flooded occasionally; subject to frost action; side slopes erodible.
Colo: Ce	Severe: water table at a depth of 3 to 8 feet; flooded occasionally; moderately slow permeability.	Moderate to severe: water table at a depth of 3 to 8 feet; flooded occasionally.	Severe: somewhat poorly drained; water table at a depth of 3 to 8 feet.	Severe: flooded occasionally; water table at a depth of 3 to 8 feet.	Severe: water table at a depth of 3 to 8 feet; flooded occasionally; fair cover soil.	Severe: high shrink-swell potential; subject to frost action.

interpretations of soils

The soils in such mapping units may have different properties and limitations and, for this reason, it is necessary to follow care-
that appear in the first column of this table]

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Reservoir areas	Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Poor: high shrink-swell potential; compaction requires close control.	Unsuited	Fair: too clayey.	Low seepage potential; moderately slow permeability.	Medium to high compressibility; hazard of shrinkage and cracking in places.	Well drained	High available water capacity; slow intake rate.	Generally not needed.
Fair: water table at a depth of 2 to 6 feet.	Sand below a depth of 1 to 1.5 feet; limited uses because of gradation.	Fair to poor: 1 to 1.5 feet of soil.	Ponds feasible; water table at a depth of 2 to 6 feet.	Subject to seepage; borrow depths limited by water table.	Seasonal water table at a depth of 2 to 6 feet; outlets not available in places.	Moderate available water capacity; flooded occasionally; wetness delays planting at times.	Not needed.
Poor: high shrink-swell potential; subject to frost action; water table at a depth of 2 to 6 feet.	Unsuited	Fair to poor: too clayey.	Low seepage potential; moderately slow permeability; water table at a depth of 2 to 6 feet.	Hazard of cracking when drying; borrow areas wet in places.	Somewhat poorly drained; water table at a depth of 2 to 6 feet; surface and tile drainage possible in places.	High available water capacity; somewhat poorly drained; slow intake rate.	Not needed.
Poor: high shrink-swell potential; high susceptibility to frost action; poorly drained; water table at a depth of 0 to 3 feet.	Unsuited	Poor: poorly drained; too clayey.	Low seepage potential; moderately slow permeability; water table at a depth of 0 to 3 feet.	High compressibility; poor bearing capacity.	Poorly drained; water table at a depth of 0 to 3 feet; drainage not feasible in most places.	Water table at a depth of 0 to 3 feet; drainage not feasible in most places.	Not needed.
Good: cut and fill slopes erodible.	Poor: sand generally lacking to depth of 4.5 feet; present below that depth in some areas.	Good to a depth of 2 feet and poor below that depth. Fair to poor where erosion and soil blowing are hazards.	High seepage potential; moderately rapid permeability.	Subject to seepage.	Well drained	Moderate available water capacity; rapid intake rate; flooded occasionally.	Not needed.
Poor: high shrink-swell potential; subject to frost action; poor compaction characteristics.	Unsuited	Fair: too clayey.	Low seepage potential.	Poor compaction characteristics; low permeability if compacted.	Somewhat poorly drained; water table at a depth of 3 to 8 feet; surface and tile drainage possible in places.	High available water capacity; slow intake rate.	Not needed.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings	Sanitary landfill [1] (area and trench types)	Local roads and streets
Crofton: CfD2, CfE2, CfF.	Moderate where slopes are less than 15 percent and severe where slopes are more than 15 percent.	Moderate where slopes are less than 7 percent and severe where slopes are more than 7 percent; moderate permeability.	Slight where slopes are less than 8 percent; moderate where slopes are 8 to 15 percent; and severe where slopes are more than 15 percent.	Moderate where slopes are less than 15 percent and severe where slopes are more than 15 percent.	Slight where slopes are less than 15 percent and moderate where slopes are more than 15 percent; good cover soil.	Moderate where slopes are less than 15 percent and severe where slopes are more than 15 percent; subject to frost action.
Inavale: In, InC.	Severe: flooded occasionally; hazard of polluting water supply.	Severe: rapid permeability; flooded occasionally; hazard of polluting water supply.	Severe: hazard of caving; flooded occasionally.	Severe: flooded occasionally; hazard of caving.	Severe: flooded occasionally; fair to poor cover soil; sandy.	Moderate: flooded occasionally; subject to frost action.
Judson: JuC	Moderate: moderate permeability.	Moderate: moderate permeability.	Slight	Moderate: moderate shrink-swell potential.	Slight: good cover soil.	Moderate: moderate shrink-swell potential; subject to frost action.
Kennebec: Ke, Ko.	Moderate: flooded occasionally; moderate permeability.	Moderate: moderate permeability.	Moderate: flooded occasionally.	Severe: flooded occasionally; subject to frost action.	Moderate: flooded occasionally; good cover soil.	Moderate: moderate shrink-swell potential; flooded occasionally; subject to frost action.
*Lamo: La, Lc. Slickspots part of unit Lc is highly variable; no valid estimates can be made.	Severe: moderately slow permeability; water table at a depth of 2 to 8 feet; flooded occasionally.	Severe: water table at a depth of 2 to 8 feet; flooded occasionally.	Moderate to severe: water table at a depth of 2 to 8 feet; flooded occasionally.	Severe: water table at a depth of 2 to 8 feet; flooded occasionally.	Severe: water table at a depth of 2 to 8 feet; fair cover soil.	Severe: high shrink-swell potential; subject to frost action.

of soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Reservoir areas	Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Fair: subject to frost action; good compaction characteristics.	Unsuited	Fair to poor: suitable material less than 8 inches thick in places; low fertility.	Moderate seepage potential; moderate permeability; rolling topography.	Fair stability; good workability; some consolidation of foundations in places when wetted and loaded; needs foundation drains in places; erodible slopes.	Well drained	High available water capacity; moderate intake rate; slopes highly erodible. Not suited on units CfE2 and CfF.	Deep soil; low fertility; erodible; steep and irregular slopes make alinement difficult.
Good: erodible if placed on slopes.	Fair for fine sand below a depth of 3 feet.	Poor: suitable material less than 8 inches thick; too sandy; low fertility.	High seepage potential; rapid permeability.	Good stability; good workability; slopes erodible; subject to seepage.	Good internal drainage; water table at a depth of 6 to 10 feet; flooded occasionally.	Low available water capacity; very rapid intake rate.	Not needed.
Fair to poor: requires close control of compaction; moderate shrink-swell potential.	Unsuited	Good	Low seepage potential; moderate permeability.	Fair compaction characteristics; slopes erodible.	Well drained	High available water capacity; slow intake rate; slopes erodible.	Deep soil; moderate permeability; slopes erodible; good length of slopes.
Fair to poor: moderate shrink-swell potential; subject to frost action.	Unsuited	Good	Low to moderate seepage potential; moderate permeability.	Good to fair compaction characteristics; slopes erodible.	Moderately well drained.	High available water capacity; moderate intake rate.	Not needed.
Poor: high shrink-swell potential; poor compaction characteristics; subject to frost action.	Unsuited	Fair: too clayey.	Water table at a depth of 2 to 8 feet; low seepage potential; moderately slow permeability; material below a depth of 4.5 feet more coarsely textured than overlying material.	Fair to poor compaction characteristics.	Somewhat poorly drained; surface and tile drainage possible where outlets are available; water table at a depth of 2 to 8 feet.	Water table at a depth of 2 to 8 feet; high available water capacity; slow intake rate; flooded occasionally.	Not needed.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings	Sanitary landfill[1] (area and trench types)	Local roads and streets
Lb	Severe: moderately slow permeability; water table at a depth of 0 to 3 feet; flooded occasionally.	Severe: water table at a depth of 0 to 3 feet; flooded occasionally.	Severe: water table at a depth of 0 to 3 feet; flooded occasionally; poorly drained.	Severe: water table at a depth of 0 to 3 feet; flooded occasionally; poorly drained.	Severe: water table at a depth of 0 to 3 feet; poor cover soil; poorly drained.	Severe: poorly drained; high shrink-swell potential; subject to frost action.
Leisy: LeC, LeD, LfC.	Severe: moderately slow permeability below a depth of 2 feet.	Moderate where slopes are 2 to 7 percent and severe where slopes are more than 7 percent.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent.	Slight: good cover soil.	Slight to moderate: hazard of erosion on some slopes; subject to frost action.
Leshara: Lh	Severe: water table at a depth of 2 to 8 feet; flooded occasionally.	Severe: water table at a depth of 2 to 8 feet; flooded occasionally.	Severe: water table at a depth of 2 to 8 feet; flooded occasionally; hazard of caving.	Severe: water table at a depth of 2 to 8 feet; flooded occasionally.	Severe: water table at a depth of 2 to 8 feet; flooded occasionally; good cover soil.	Severe: water table at a depth of 2 to 8 feet; flooded occasionally; subject to frost action.
Marsh: Mh. Material variable; severe limitations for all uses.						
Moody: MoC, MoC2, MoD, MoD2.	Severe: moderately slow permeability.	Moderate where slopes are less than 7 percent and severe where slopes are more than 7 percent.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent.	Moderate: high shrink-swell potential; subject to frost action; moderately slow permeability.	Slight for area type where slopes are less than 8 percent and moderate where slopes are more than 8 percent; moderate for trench type: too clayey; fair cover soil.	Moderate to severe: moderate to high shrink-swell potential; subject to frost action.

of soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Reservoir areas	Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Poor: high shrink-swell potential; poor compaction characteristics.	Unsuited	Fair to poor: too clayey; poorly drained.	Water table at a depth of 0 to 3 feet; low seepage potential; moderately slow permeability; material below a depth of 3 feet more coarsely textured than overlying material.	Fair to poor compaction characteristics.	Poorly drained; surface and tile drainage possible where outlets are available; water table at a depth of 0 to 3 feet.	Poorly drained; water table at a depth of 0 to 3 feet; not suited.	Not needed.
Good to a depth of 2 feet; fair in subsoil; moderate shrink-swell potential; subject to frost action.	Unsuited	Good	Subsoil has moderately slow permeability.	Fair compaction characteristics; compacted soil has moderately slow to slow permeability.	Well drained	High available water capacity; moderate intake rate; slopes erodible.	Slopes erodible; gently rolling landscape; hazard of soil blowing.
Fair to poor; water table at a depth of 2 to 8 feet; subject to frost action.	Unsuited	Good	Moderate to high seepage losses; moderate permeability.	Fair stability; susceptible to seepage; fair to good compaction characteristics; slopes erodible.	Somewhat poorly drained; good to fair internal drainage; no surface drainage outlets available in places; water table at a depth of 2 to 8 feet.	High available water capacity; moderate intake rate; water table at a depth of 2 to 8 feet.	Not needed.
Fair to poor: moderate to high shrink-swell potential; subject to frost action; requires close control of compaction.	Unsuited	Fair: too clayey.	Low seepage losses; moderately slow permeability.	Slow permeability for compacted soil; fair to good compaction characteristics; requires close control of compaction; consolidation of foundations in places upon wetting and loading.	Well drained	High available water capacity; slow intake rate; slopes highly erodible.	Slopes erodible; gently sloping and strongly sloping soils; moderately slow permeability.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings	Sanitary landfill [1] (area and trench types)	Local roads and streets
Nora: NoD, NoD2, NoE, NoE2.	Moderate: moderate permeability; slopes range from 6 to 15 percent.	Moderate where slopes are less than 7 percent and severe where slopes are more than 7 percent.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent.	Slight to moderate: moderate shrink-swell potential; subject to frost action; slopes may limit some types of construction.	Slight for area type where slopes are less than 8 percent and moderate where slopes are more than 8 percent; trench type needed where slopes are more than 8 percent; good cover soil.	Slight to moderate: moderate shrink-swell potential; subject to frost action; hazard of erosion where slopes are more than 8 percent.
Sandy alluvial land: Sa. Material variable; severe limitations for most uses.						
Silty alluvial land: Sy. Material variable; severe limitations for most uses.						
Slickspots. Mapped only with Lamo soils; material variable; severe limitations for most uses.						
*Thurman: TvB, TvC, TvD. For Valentine parts of these units, see Valentine series.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent; hazard of polluting water supply.	Severe: rapid permeability; hazard of polluting water supply.	Severe: coarse texture; hazard of caving.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent; hazards of caving and erosion.	Severe: rapid permeability; hazard of polluting water supply; cover soil subject to soil blowing.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent; hazards of water erosion and soil blowing.

of soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Reservoir areas	Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Fair to poor: moderate shrink-swell potential; subject to frost action; requires close control of compaction.	Unsuited	Fair: suitable material less than 8 inches thick in places.	Moderate seepage potential; moderate permeability; rolling topography.	Slow permeability for compacted soil; fair to good workability; requires close control of compaction; consolidation of foundations in places upon wetting and loading; foundation drains needed in places; slopes erodible.	Well drained	High available water capacity; slow intake rate; slopes highly erodible; not suitable on strongly sloping and moderately steep slopes.	Slopes erodible; strongly sloping and moderately steep slopes; outlets generally available.
Good: loose sand makes hauling difficult in places; slopes erodible by wind and water; compaction by vibration needed in places.	Good to fair for fine sand.	Poor: coarse textured.	Rapid permeability; high seepage losses; gently undulating to rolling landscape.	High seepage potential; erodible by wind and water.	Somewhat excessively drained; rapid permeability; generally not needed.	Low available water capacity; very rapid intake rate; hazards of water erosion and soil blowing.	Not suited.

TABLE 6.—*Engineering interpretations*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings	Sanitary landfill [1] (area and trench types)	Local roads and streets
Valentine: VaD	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent; hazard of polluting water supply.	Severe: rapid permeability; hazard of polluting water supply.	Severe: coarse texture; hazard of caving.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent; hazard of caving.	Severe: rapid permeability; sandy cover soil; hazards of polluting water supply and soil blowing.	Slight where slopes are less than 8 percent and moderate where slopes are more than 8 percent; hazard of soil blowing.
Wann: Wm	Severe: water table at a depth of 3 to 8 feet; flooded occasionally; hazard of polluting water supply.	Severe: water table at a depth of 3 to 8 feet; moderately rapid permeability; flooded occasionally; hazard of polluting water supply.	Severe: water table at a depth of 3 to 8 feet; flooded occasionally; hazard of caving below a depth of 4 feet.	Severe: water table at a depth of 3 to 8 feet; flooded occasionally; hazard of caving below a depth of 4 feet.	Severe: water table at a depth of 3 to 8 feet; flooded occasionally; good cover soil to a depth of 3 feet.	Slight to moderate: somewhat poorly drained; subject to frost action.
Zook: Zo, Zw	Severe: slow permeability; water table at a depth of 3 to 8 feet; flooded occasionally; hazard of polluting water supply.	Moderate to severe: water table at a depth of 3 to 8 feet; flooded occasionally.	Moderate to severe: water table at a depth of 3 to 8 feet; flooded occasionally; construction requires relatively dry conditions.	Severe: flooded occasionally; subject to frost action; high shrink-swell potential.	Severe: water table at a depth of 3 to 8 feet; flooded occasionally; poor cover soil; subject to cracking when drying.	Severe: high shrink-swell potential; somewhat poorly drained; subject to frost action.

[1] Onsite deep studies of the underlying strata, water table, and hazards of aquifer pollution and drainage into ground water

water content within which a soil material is considered to be plastic. The liquid limit and plasticity index are estimated in table 5, but in table 7 they are based on tests of soil samples.

Permeability is the rate at which water moves through an undisturbed soil in a vertical direction under a unit head of pressure. It is estimated on the basis of structure, texture, density, and other soil characteristics observed in the field. Lateral seepage or transient soil features such as plowpans and surface crusts are not considered.

Available water capacity is a measure of the capacity of soils to hold water for use by most plants. It is defined as the difference between the amount of water in a soil at field capacity and the amount at the wilting point of most plants.

Reaction of a soil is the degree of acidity or alkalinity, expressed as a pH value or reaction class. The pH value and terms used to describe soil reaction are explained in the Glossary at the back of this survey.

Shrink-swell potential is an indication of the change in volume to be expected in a soil when the moisture content is changed. It rates the extent to which the soil shrinks as it dries or swells when it gets wet. Generally, soils with a high clay content have a high shrink-swell potential, and clean sands and gravels have a low shrink-swell potential. For engineering purposes, soils having a high shrink-swell potential are the most hazardous. Shrinking and swelling of soils can damage building foundations, roads, and other structures. In table 5, the shrink-swell potential is not indicated for soils that shrink markedly on drying but do not swell quickly on rewetting.

Engineering interpretations of the soils

The soils of Cuming County are summarized in table 6 with respect to their usefulness for various engineering purposes. The interpretations are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and in other nearby

of soils—Continued

Suitability as source of—			Soil features affecting—				
Road fill	Sand	Topsoil	Reservoir areas	Embankments, dikes, and levees	Drainage of crops and pasture	Irrigation	Terraces and diversions
Good to fair: lacks stability under load where dry; loose sand makes hauling difficult in places.	Good to fair for fine sand.	Poor: coarse textured; low fertility.	Rapid permeability; high seepage losses; rolling landscape.	High seepage potential; medium high susceptibility to piping; low compressibility; hazard of soil blowing.	Excessively drained; rapid permeability; generally not needed.	Low available water capacity; very rapid intake rate; hazards of water erosion and soil blowing.	Not suited.
Good to fair: requires close control of compaction to a depth of 4 feet; subject to frost action.	Good for fine sand below a depth of 4 feet.	Good	Moderately rapid permeability; moderate to high seepage losses; water table at a depth of 3 to 8 feet.	Subject to seepage in places; slopes erodible; borrow areas wet in places.	Somewhat poorly drained; water table at a depth of 3 to 8 feet; moderately rapid permeability.	High available water capacity; rapid intake rate; moderately rapid permeability.	Not needed.
Poor: high shrink-swell potential; subject to frost action.	Unsuited	Fair to a depth of 16 inches in unit Zo and poor in unit Zw; too clayey.	Low seepage losses; slow permeability; water table at a depth of 3 to 8 feet.	Poor compaction characteristics; low permeability for compacted soil; borrow areas wet in places.	Somewhat poorly drained; very slow runoff; no adequate outlets in places; water table at a depth of 3 to 8 feet; clayey soil material; slow permeability.	High available water capacity; very slow to slow intake rate; needs adequate drainage; slow permeability.	Not needed.

should be made for landfill deeper than 5 to 6 feet.

or adjoining areas, and on information obtained from engineers and soil scientists acquainted with the soils of the county. In table 6, the soils are rated with respect to their limitations for use as septic tank absorption fields, sewage lagoons, shallow excavations, dwellings with or without basements, sanitary landfill, and local roads and streets. The soils are also rated with respect to their suitability as a source of road fill, sand, and topsoil. In addition, the table gives soil features that affect the planning, installation, and maintenance of reservoir areas, embankments, drainage of crops and pasture, irrigation, and terraces and diversions. The ratings, uses of the soils, and characteristics affecting these uses are discussed in the following paragraphs.

The limitations of a soil for a specified use are rated *slight, moderate, severe,* or *very severe. Slight* means soil properties generally are favorable for the stated use or, in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required. *Very severe* means one or more soil properties are so unfavorable that overcoming the limitations is most difficult and costly and commonly is not practical.

The suitability of a soil for a specified use is rated *good, fair,* or *poor*. The meanings of these ratings approximately parallel those of the terms slight, moderate, and severe, respectively.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. In table 6, soil material from a depth of 18 inches to 5 feet is evaluated in reference to its effect on both the absorption of effluent and the construction and operation of the system. Permeability of the soil, susceptibility to flooding, and depth to the water table affect absorption. The slope

TABLE 7.—*Engineering*

[Tests performed by the Nebraska Department of Roads in accordance with standard

Soil name and location	Parent material	Report number	Depth	Moisture density [1]		Specific gravity
				Maximum dry density	Optimum moisture	
			Inches	*Lbs per cu ft*	*Percent*	
Belfore silty clay loam: 600 feet N. and 150 feet E. of SW. corner of sec. 33, T. 24 N., R. 6 E. (Modal)	Loess.	S31-110	0-7	97	21	2.57
		S31-111	24-33	102	20	2.56
		S31-112	47-54	105	20	2.66
Calco silty clay loam: 850 feet W. and 400 feet S. of NE. corner of sec. 34, T. 22 N., R. 7 E. (Modal)	Alluvium.	S71-128	0-9	----------	----------	2.63
		S71-129	35-48	----------	----------	2.65
		S71-130	48-56	----------	----------	2.64
Colo silty clay loam: 250 feet S. and 150 feet E. of NW. corner of sec. 32, T. 22 N., R. 5 E. (Modal)	Alluvium.	S71-131	0-8	----------	----------	2.60
		S71-132	34-54	----------	----------	2.63
Crofton silt loam: 0.25 mile E. and 225 feet S. of NW. corner of sec. 7, T. 21 N., R. 4 E. (Modal)	Loess.	S71-144	0-6	----------	----------	2.70
		S71-145	6-16	----------	----------	2.72
Judson silty clay loam: 1,500 feet W. and 300 feet S. of NE. corner of sec. 33, T. 22 N., R. 5 E. (Modal)	Colluvium and alluvium.	S71-133	0-8	----------	----------	2.66
		S71-134	21-35	----------	----------	2.63
		S71-135	35-41	----------	----------	2.63
Leisy fine sandy loam: 2,500 feet N. and 120 feet W. of SW. corner of sec. 23, T. 23 N., R. 4 E. (Modal)	Eolian sand over loess.	S73-250	0-8	----------	----------	2.60
		S73-251	18-22	----------	----------	2.63
		S73-252	32-46	----------	----------	2.68
Moody silty clay loam: 0.3 mile S. and 200 feet W. of NE corner of sec. 3, T. 21 N., R. 4 E. (Modal)	Loess.	S71-146	0-7	----------	----------	2.61
		S71-147	12-26	----------	----------	2.69
		S71-148	36-54	----------	----------	2.59
Nora silty clay loam: 0.27 mile W. and 200 feet S. of NE corner of sec. 27, T. 22 N., R. 5 E. (Modal)	Loess.	S71-136	0-7	----------	----------	2.62
		S71-137	17-22	----------	----------	2.69
		S71-138	29-46	----------	----------	2.72
Thurman loamy fine sand: 0.45 mile W. and 200 feet N. of SE. corner of sec. 24, T. 21 N., R. 6 E. (Modal)	Eolian sand.	S71-142	0-6	----------	----------	2.66
		S71-143	19-34	----------	----------	2.64
Zook silty clay loam: 1,200 feet W. and 120 feet S. of NE. corner of sec. 30 T. 23 N., R. 6 E. (Modal)	Alluvium.	S71-139	0-7	----------	----------	2.61
		S71-140	19-32	----------	----------	2.69
		S71-141	32-47	----------	----------	2.65
Zook silty clay: 1,000 feet N. and 200 feet E. of SW. corner of sec. 30, T. 24 N., R. 4 E. (Modal)	Alluvium.	S71-149	0-5	----------	----------	2.65
		S71-150	22-35	----------	----------	2.66
		S71-151	40-60	----------	----------	2.69

[1] Based on AASHO Designation: T 99-57, Method A (*1*).

[2] Mechanical analysis according to AASHO Designation: T 88-57 (*1*). Results by this procedure may differ somewhat from results 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 and the material coarser than 2 millimeters in diameter is excluded in calculating grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

of the soil affects the difficulty of layout and construction and also influences lateral seepage, the downslope flow of effluent, and the possibility of erosion. Large rocks and boulders in the soil increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet for a period long enough for bacteria to decompose the solids. Such lagoons should be protected from flooding. The floor of a lagoon is nearly level and the sides, or embankments, are of soil material that generally is compacted to medium density. The permeability and slope of the soil and its organic-matter content affect the pond floor. If the floor needs to be leveled, depth to bedrock is also important. Engineering properties of the soil as interpreted from the Unified soil classification af-

test data

procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—					Percentage smaller than—							
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 60 (0.25 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHO [3]	Unified [4]
									Percent			
--------	--------	--------	100	99	96	71	45	38	42	16	A-7-6(11)	ML-CL
--------	--------	--------	--------	100	98	72	46	38	50	25	A-7-6(16)	CL
--------	--------	--------	--------	100	97	70	41	34	42	19	A-7-6(12)	CL
--------	--------	--------	100	99	90	64	44	32	50	23	A-7-6(15)	ML-CL
--------	--------	--------	100	99	96	70	46	37	55	29	A-7-6(19)	CH
--------	--------	--------	100	99	94	68	40	32	52	28	A-7-6(18)	CH
--------	--------	--------	100	99	94	56	32	25	45	18	A-7-6(12)	ML-CL
--------	--------	--------	100	99	93	57	34	25	44	20	A-7-6(13)	CL
--------	--------	--------	100	99	95	46	33	27	44	20	A-7-6(13)	CL
--------	--------	--------	100	99	95	49	28	22	39	16	A-6(10)	CL
--------	--------	--------	100	99	94	54	35	29	39	14	A-6(10)	ML-CL
--------	--------	--------	100	99	93	55	32	21	44	15	A-7-6(11)	ML
--------	--------	--------	100	99	95	53	33	24	41	16	A-7-6(11)	ML-CL
--------	100	98	87	27	20	12	10	8	[5]NP	NP	A-2-4(0)	SM
--------	100	99	90	37	30	19	15	13	19	1	A-4(0)	SM
--------	--------	100	98	86	77	44	32	28	41	18	A-7-6(11)	CL
--------	--------	--------	100	98	95	54	33	29	40	15	A-6(10)	ML-CL
--------	--------	--------	100	99	95	53	35	29	44	20	A-7-6(13)	CL
100	99	98	98	97	93	52	34	28	41	19	A-7-6(12)	CL
--------	--------	--------	100	99	95	60	39	31	49	18	A-7-5(13)	ML
--------	--------	--------	100	99	96	60	41	33	51	22	A-7-6(15)	MH-CH
[6]99	97	96	96	96	95	59	36	31	44	18	A-7-6(12)	ML-CL
--------	100	97	85	11	9	7	5	4	[5]NP	[5]NP	A-2-4(0)	SW-SM
--------	100	97	85	7	6	4	3	2	[5]NP	[5]NP	A-3(0)	SW-SM
--------	--------	100	99	97	94	74	47	35	51	22	A-7-6(15)	MH-CH
--------	--------	--------	100	99	95	75	51	46	58	33	A-7-6(20)	CH
--------	--------	--------	100	99	94	74	45	39	52	28	A-7-6(18)	CH
--------	--------	100	99	98	96	71	49	39	58	31	A-7-6(20)	CH
--------	100	99	99	96	92	70	49	41	58	32	A-7-6(20)	CH
[6]99	98	96	96	88	84	65	49	39	56	33	A-7-6(19)	CH

[3] Based on AASHO Designation: M 145-49 (*1*).
[4] Based on the Unified Soil Classification System (*7*).
[5] NP = nonplastic.
[6] 100 percent passes ⅜-inch sieve.

fect the embankment. Rocks and stones in the soil adversely influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet. These include excavations for pipelines, sewerlines, telephone and transmission lines, basements, open ditches, and cemeteries. Good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table are desirable properties of soils to be used for excavations.

Dwellings, as rated in table 6, are not more than three stories high and are supported by foundations or footings placed in undisturbed soil. Properties that affect the rating of a soil for dwellings are those that relate to capacity to support load and to resist settlement under load and those that relate to ease of excavation. Wetness of the soil, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential affect the capacity to support load. Wetness, slope, depth to bedrock, and the presence of stones and rocks affect ease of excavation.

Sanitary landfill is a method of disposing of refuse.

Both the trench and area types of landfill are considered in table 6. In each type, the waste is spread in thin layers, compacted, and covered with soil at intervals throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. The best soils for landfill have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. The possible hazard of polluting the ground water is a consideration that affects the suitability of a soil for landfill. Unless otherwise stated, the ratings in table 6 apply only to soil material within a depth of 5 feet. Therefore, limitations rated *slight* or *moderate* may not be valid if trenches are to be much deeper than that. Soils should be tested before a site is selected.

Local roads and streets, as rated in table 6, are all-weather roads that are expected to carry automobile traffic all year. They have a subgrade of soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water, and they have ordinary provisions for drainage. They are built mainly from the soil at hand, and most cuts and fills are less than 6 feet deep. The design and construction of roads and streets are affected by the load supporting capacity and stability of the subgrade and by the workability and quantity of available cut and fill material. The AASHO and Unified classifications of the soil material and the shrink-swell potential indicate traffic supporting capacity. Wetness and flooding affect stability of the material. The slope and wetness of the soil, depth to hard rock, and the presence of stones and rocks affect the ease of excavation and the amount of cut and fill needed to obtain an even grade.

Road fill is soil material used in embankments for roads. The suitability ratings in table 6 reflect (1) the predicted performance of the soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand is used in large quantities in many kinds of construction. The ratings in table 6 indicate probable sources for this material. A soil rated *good* or *fair* generally has a layer of sand that is at least 3 feet thick and the top of the layer is within a depth of 5 feet. The ratings do not take into account the thickness of overburden, the location of the water table, or other factors that affect mining of the materials, and neither do they indicate the quality of the deposit.

Topsoil is used for preparing a seedbed or for topdressing an area where vegetation is to be established and maintained. The suitability of a soil as topsoil depends mainly on the ease of working and spreading the soil material, on the natural fertility of the material or the response of plants when fertilizer is applied, and on the absence of substances toxic to plants. To a lesser degree, suitability is affected by the texture of the soil material and the presence of stone fragments. Damage that will result at the area from which topsoil is taken also is considered in the ratings in table 6.

Reservoirs hold water behind a dam or embankment. Soils suitable for reservoir areas have a low seepage potential. The permeability of a soil and the depth to fractured or permeable bedrock or other permeable material affect seepage.

Embankments, dikes, and levees require soil material that has high stability, shear strength, and compactibility and low shrink-swell potential. The soil material should be resistant to seepage and piping. The presence of stones or organic material in the soil is undesirable.

Drainage of cropland is affected by the permeability, slope, texture, and structure of the soil; depth to claypan, rock, or other layers that influence the rate of water movement; depth to the water table; the stability of soil material in ditchbanks; the susceptibility of the area to stream overflow; and the availability of outlets for drainage.

The suitability of a soil for irrigation is affected by the slope, texture, and available water capacity of the soil; susceptibility of the area to stream overflow, water erosion, or soil blowing; presence of stones and accumulations of salts and alkali in the soil; depth to the root zone; rate of water intake at the surface; permeability of soil layers below the surface layer or of layers that restrict movement of water; depth to the water table or bedrock; and the need for drainage.[7]

Terraces and diversions are embankments or ridges constructed across the slope to intercept runoff, which then soaks into the soil or flows slowly to a prepared outlet. Features that affect the suitability of a soil for terraces are uniformity and steepness of slope, depth to bedrock or other unfavorable material, presence of stones, permeability, and resistance to water erosion, soil slipping, and soil blowing.

Engineering test data

Tests were made on 11 profiles of 10 of the soil series in Cuming County to help evaluate the soils for engineering purposes. Data from these tests are given in table 7. The engineering classifications given in the last two columns of the table are based on data obtained by mechanical analyses and on tests to determine the liquid and plastic limits. The mechanical analyses were made by a combination of the sieve and hydrometer methods. As explained in the section "Soil Properties Significant to Engineering," tests for liquid limit and plastic limit measure the effect of water on the consistence of soil material.

Compaction (or moisture-density) properties of the soils are important in earthwork. If a soil material is compacted at successively higher moisture content while the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with the increase in moisture content. The highest dry density obtained in the compactive test is termed the *maximum dry density*. Generally, the maximum strength of earthwork is obtained where the soil is compacted to the maximum dry density.

[7] For further information on the use of soil for irrigation, see "Irrigation Guide for Nebraska," Soil Conservation Service, 1971.

Formation and Classification of Soils

The first part of this section describes the factors that have affected formation and development of soils in Cuming County. The second part explains the system of soil classification currently used and classifies each soil series represented in the county according to that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on parent material that accumulated through weathering of rock. The characteristics of soil at any given place are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material accumulated and existed since accumulation, (3) the plant and animal life on and in the soil since the beginning of its formation, (4) the relief, or lay of the land, and (5) the length of time that forces of soil formation acted on the soil material. These five factors of soil formation are closely interrelated in their effects on the soil. Few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Moreover, many of the processes of soil development are only poorly understood.

The parent material affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Climate and plant and animal life act on the parent material and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. Usually, long periods of time are needed for changing the parent material into a soil profile and for differentiating the soil into distinct horizons.

Parent material

Parent material is the disintegrated and partly weathered rock in which soil forms. It determines the mineralogical and chemical composition of the soil. The soils of Cuming County formed in four kinds of parent material: loess (specifically, Peoria loess), colluvium, alluvium, and eolian sand.

Loess in Cuming County is brown or yellowish-brown, friable, calcareous material that was blown out of river and stream valleys and deposited by the wind on uplands. It consists mostly of silt but contains some clay and small amounts of sand. The thickness of the loess deposits averages 20 to 30 feet but ranges from a few feet to more than 100 feet. Belfore, Crofton, Leisy, Moody, and Nora soils formed in loess and have more strongly developed profiles than soils that formed in younger materials. These soils make up about 67 percent of the county.

Colluvium, which occurs on foot slopes adjacent to the steeper uplands, consists of recent, deep sediment of friable material deposited by the combined effects of gravity and moving water. The deposits are mostly silt but contain some clay. They are mainly dark grayish brown or brown and generally range from 2 to 6 feet in thickness. In Cuming County, only Judson soils formed in colluvium. These soils make up about 9 percent of the county.

Alluvium is water-deposited sediment on stream terraces and bottom lands. In Cuming County, this sediment ranges from clay to fine sand in texture. Because fresh deposits are laid down by floodwaters after heavy rains or rapid melting of snow, soils formed in alluvium are immature. The most extensive alluvial deposits are along the Elkhorn River and Plum and Logan Creeks, all of which originate outside the county. Some deposits occur along the many, small, local streams that originate in the uplands within the county. Boel, Cass, Inavale, and Wann soils formed in alluvium. They make up about 19 percent of the county.

Eolian sand is a wind deposit that forms dunes on or thinly mantles the loess uplands. The sand was blown out of the Elkhorn River valley by northwesterly winds and was deposited on the loess in two areas. The mantle ranges from a few feet to 30 feet in thickness. This sand is finer textured than that in the Sandhills of central Nebraska. Thurman and Valentine soils formed in eolian sand. They make up about 4 percent of the county.

Climate

Climate affects the formation of soils through its influence on the rate of weathering and reworking of parent material by rainfall, temperature, and wind. Because soil formation progresses slowly when the soil is dry, soils in arid regions generally are less well developed than those in humid regions. The amount of moisture, the length of the growing season, and the prevailing temperature during the growing season affect the amount of vegetation, which is the principal source of organic matter in soils. These same factors directly affect the activity of the micro-organisms that convert organic matter to humus. Wind also is an important factor in that it can remove the top layer of soil or it can deposit a mantle of sediment on soil.

Cuming County has a continental climate characterized by wide day-to-day and season-to-season variations. Temperatures below 0° F in winter and above 100° in summer are common. The frost-free season averages 160 days and thus provides an adequate growing season for many grain and forage crops. The average annual precipitation is 28.3 inches, of which 12 percent is in the form of snow and 88 percent in the form of rain. The average snowfall is 34.3 inches a year.

The climate is fairly uniform throughout the county. Thus, differences in the soils from one place to another are the result not of climate alone but of the interrelationship of climate and other soil-forming factors. The amount of leaching, for example, is dependent not only on the amount of precipitation but also on the relief in the area. Because runoff and evaporation are greater, leaching is less in the steeper soils and on soils that are exposed more directly to the wind than in the nearly level soils that receive the same amount of rainfall. Erosion, which is caused by rain, melting snow, and wind, can prevent development of a thick surface layer, especially on the steeper areas.

Plant and animal life

Plants, animals, bacteria, fungi, earthworms, insects, and other organisms are important and active in soil-forming processes. The plants and animals that live in and on the soil are affected in turn by the other soil-forming factors: climate, relief, time, and parent material.

The native vegetation in Cuming County was mainly tall grasses. Each year these grasses produced vegetation that died and formed organic matter, which gradually changed to humus and gave the soil its dark color. The roots of the tall grasses helped keep the soils productive by bringing water from the deeper horizons and thus contributing soluble minerals such as calcium, iron, phosphorus, nitrogen, and sulfur. Plant roots not only produced useful nutrients for plants, but also helped to develop better soil structure and to aerate the soil. Along the principal streams, trees and woody plants produced different kinds and amounts of organic matter.

When plants decay, micro-organisms act upon the organic matter and decompose it into stable humus. These micro-organisms include bacteria, nematodes, and protozoa. Nitrogen-fixing bacteria in nodules on the roots of certain legumes remove nitrogen from the air and, when the bacteria die, the nitrogen becomes available in the soil. Fungi and such small animals as millipedes, spiders, and mites also act upon organic matter and decompose it into humus. Earthworms, insects, and small burrowing animals affect the formation of soils by mixing and working the organic and mineral matter. The mixing and working speed soil development and make the soil more friable.

Relief

Relief, or lay of the land, influences the formation of soil mainly through its effect on drainage, runoff, and vegetative growth. The degree of slope, shape of the surface, and permeability of the soil determine the rate of runoff, the internal drainage, and the moisture content of the soil. Internal drainage and availability of moisture are important factors in forming the horizons of a soil.

On steep slopes, where runoff is rapid and little moisture penetrates the soil, development of the soil is slower than on gentler slopes. Erosion removes the surface soil almost as fast as it is formed. Lime and other elements are not leached deeply. In Cuming County, the steep Crofton soils have little soil profile development other than a slightly darkened, thin surface layer.

The nearly level and gently sloping soils on uplands have stronger development and more distinct soil horizons than the steeper soils. They absorb more moisture, and percolation is deeper into the profile. Consequently, lime and plant nutrients are leached to greater depths, and a B horizon develops. The nearly level and gently sloping Moody and Belfore soils have distinct horizons.

Some of the nearly level soils on bottom lands are somewhat poorly drained because of slow runoff or a moderately high water table. Where runoff is slow, water penetrates the soil, causes silt to weather to clay, and leaches certain elements into lower horizons. Where the water table is moderately high, water is brought from the zone of saturation to the root zone by capillary action and is used by plants. The moisture in the soil affects the kind and amount of vegetation, which in turn influences soil development. In Cuming County, the Colo, Calco, and Zook soils are somewhat poorly drained.

Time

Time is needed for the active agents of soil development to form soils from parent material. Some soils form much more rapidly than others. The length of time for a particular soil to form depends on the other factors involved.

Young immature soils or land types lack well-defined horizons because they have been exposed to soil-forming factors for only a short period of time. These young soils include soil material recently exposed by erosion on steep or poorly protected slopes and sediments deposited by flooding on bottom land. In Cuming County, Silty alluvial land and Sandy alluvial land are land types that lack well-defined horizons.

Older immature soils have a well-developed, darkened surface layer but lack a well-developed subsoil. These soils formed in material that has been in place for a relatively short period of time and thus have not formed a thick, well-defined profile. They include Cass, Leshara, and Wann soils on bottom lands and Thurman and Valentine soils on uplands.

Old or mature soils have a well-developed subsoil. Soil materials in which these soils formed have been in place long enough for climate, plant and animal life, and relief to alter the parent material. In Cuming County, Belfore and Moody soils are mature and thus have a well-developed B horizon.

Classification of Soils

Soils are classified so that we can more easily distinguish 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 understand their behavior and their response to manipulation. Through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

In a classification system, soils are placed in broad categories to facilitate study and comparison in large areas, such as countries and continents. These broad categories are divided and subdivided into narrower classes that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing agricultural land and woodland, in developing rural areas, in engineering work, and in many other ways. The system of classifying soils that is currently used was adopted by the National Cooperative Soil Survey in 1965. This system is under continual study, and readers interested in the latest developments of the system should refer to the available literature *(2, 5)*.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the 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 or measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. The same property or subdivisions of this property can be used in several different categories. Table 8 shows the classification of each soil series in Cuming County by family, subgroup, and order according to the present system, which is current as of August 1973. Classes of the current system are defined briefly in the following paragraphs.

ORDERS. Ten soil orders are recognized. The properties that differentiate these orders generally are those that tend to give broad climatic groupings of soils. However, three of the orders—the Entisols, Histosols, and Vertisols—occur in many different climates. The name of each order is a three or four syllable word ending in *sol* (for example, Moll-i-sol).

SUBORDERS. Each order is divided into suborders on the basis of soil characteristics that seem to produce classes having the greatest genetic similarity. A suborder has a narrower climatic range than an order. The soil properties used to separate suborders are mainly those that reflect the presence or absence of a water table at a shallow depth; the climate of the soil; the accumulation of clay, iron, or organic carbon in the upper part of the solum; the cracking of the soil caused by a decrease in soil moisture; and fine stratification. The first syllable of the name of each suborder indicates a soil property and the second, or last, shows the order. For example, *Aqu* in the name Aquoll indicates water or wetness in the soil and *oll* shows the order is Mollisol.

GREAT GROUPS. Soil suborders are divided 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, carbonates, and other constituents have accumulated or have been removed; or those that contain a claypan that interferes with the growth of roots, movement of water, or both. Among features considered are the acidity, climate, composition, and color of the soil. The name of each great group is made by adding a defining prefix of one or two syllables to the name of the suborder. For example, *Hapl* in the name Haplaquoll indicates the soil has simple horizons and that *Aquoll* is the suborder.

SUBGROUPS. Great groups are divided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups also are made in instances where soil properties intergrade outside the range of any other great group, suborder, or order. The name of each subgroup is derived by placing one or more adjectives before the name of the great group. For example, the name Typic Haplaquoll means that the soil is a typical Haplaquoll.

FAMILIES. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, soil depth, and consistence. The name of a family consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and other properties that are used to differentiate family as, for example, the fine-silty, mixed, mesic family of Typic Haplaquolls (see table 8).

SERIES. Families are divided into smaller groups called series. A series consists of a group of soils that formed from a particular kind of parent material having genetic horizons which, except for the texture of the surface soils, are similar in differentiating characteristics and in arrangement in the profile. Among these characteristics are color, texture, structure, consistence, reaction, and mineralogical and chemical composition. A series commonly is named after the geographical location at or near the place where the series was first observed and mapped.

Physical and Chemical Analyses

Information useful to soil scientists in classifying soils and in developing concepts of soil genesis can be obtained from laboratory analyses of the soils. Information thus obtained is helpful in estimating available water capacity, permeability, organic-matter

TABLE 8.—*Classification of soil series*

Series	Family	Subgroup	Order
Belfore	Fine, montmorillonitic, mesic	Udic Haplustolls	Mollisols.
Boel	Sandy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.
Calco	Fine-silty, mixed (calcareous), mesic	Cumulic Haplaquolls	Mollisols.
Cass	Coarse-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Colo	Fine-silty, mixed, mesic	Cumulic Haplaquolls	Mollisols.
Crofton	Fine-silty, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Inavale	Mixed, mesic	Typic Ustipsamments	Entisols.
Judson	Fine-silty, mixed, mesic	Cumulic Hapludolls	Mollisols.
Kennebec	Fine-silty, mixed, mesic	Cumulic Hapludolls	Mollisols.
Lamo	Fine-silty, mixed (calcareous), mesic	Cumulic Haplaquolls	Mollisols.
Leisy	Fine-loamy, mixed, mesic	Udic Argiustolls	Mollisols.
Leshara	Fine-silty, mixed, mesic	Typic Haplaquolls	Mollisols.
Moody	Fine-silty, mixed, mesic	Udic Haplustolls	Mollisols.
Nora	Fine-silty, mixed, mesic	Udic Haplustolls	Mollisols.
Thurman	Sandy, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Valentine	Mixed, mesic	Typic Ustipsamments	Entisols.
Wann	Coarse-loamy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.
Zook	Fine, montmorillonitic, mesic	Cumulic Haplaquolls	Mollisols.

TABLE 9.—*Temperature and precipitation data*

[Data for West Point during 1940–70, except as indicated]

Month	Temperature				Precipitation				
	Average daily—		Average monthly—		Average total	1 year in 10 will have—		Average number of days having snow cover of 1 inch or more [1]	Average depth of snow on days having snow cover [1]
	High	Low	High	Low		Equal to or less than—	Equal to or more than—		
	°F	*°F*	*°F*	*°F*	*Inches*	*Inches*	*Inches*		*Inches*
January	30	10	53	−16	0.8	0.2	1.7	20	5
February	36	15	56	−8	1.1	.2	2.3	11	5
March	45	24	71	2	1.5	.4	2.9	12	6
April	63	38	85	21	2.5	.9	4.0	([2])	3
May	74	49	92	32	4.0	2.2	6.8	----------	----------
June	83	59	97	44	5.4	3.0	9.8	----------	----------
July	89	64	101	52	3.2	1.0	5.8	----------	----------
August	87	62	99	49	3.4	1.0	5.2	----------	----------
September	77	52	93	34	3.0	.5	5.3	----------	----------
October	67	41	85	23	1.7	.1	4.5	([2])	1
November	49	27	70	7	.9	.1	2.3	2	2
December	36	16	58	−7	.8	.1	1.3	9	3
Year	61	38	[3] 102	[4] −18	28.3	20.3	34.8	54	5

[1] Based on period 1950–71. Data for Lyons, Burt County, Nebr.
[2] Less than half a day.
[3] Average annual highest temperature.
[4] Average annual lowest temperature.

content, fertility, tilth, and other soil characteristics that affect soil management.

Samples of Belfore soils from Cuming County and of Moody, Nora, and Crofton soils from nearby counties were collected for physical and chemical analyses by the Soil Survey Laboratory of the Soil Conservation Service in Lincoln, Nebraska. Each soil sampled is considered typical of that soil in Cuming County. Data resulting from the laboratory analyses have been published by the Department of Agriculture *(6)*.

General Nature of the County

This section is mainly for those not familiar with the area. Information is given on the relief, drainage, climate, water supply, native vegetation, natural resources, and trends in land use in Cuming County. Industry, transportation, and available services are briefly discussed in the pages that follow.

Relief and Drainage

Cuming County is in the northern part of the rolling hills topographic region of Nebraska. Long slopes, rolling hills, and broad, low-gradient valleys are characteristic of the landscape. The elevation ranges from 1,275 feet on the bottom lands of the Elkhorn River in the southern part of the county to 1,600 feet on the uplands in the northwestern part, a difference of 325 feet. The elevation of most of the county is between 1,300 and 1,500 feet.

The county is wholly within the area drained by the Elkhorn River. In general, surface drainage is to the east and south. The Elkhorn River enters the county 6 miles south of the northwest corner and leaves the county 9 miles west of the southeast corner. Plum, Rock, Sand, Leisy, Coffee, and Fisher Creeks are the principal tributaries that empty into the Elkhorn River within the county. Other streams that drain parts of Cuming County but empty into the Elkhorn downstream from the south county line are Logan, Pebble, Maple, and Cuming Creeks. All the named creeks are fed by many small streams and drainageways.

Climate [8]

Cuming County has a continental climate characterized by moderate precipitation, warm summers, and cold winters. Wide variations in precipitation and temperature occur from day to day and from season to season. Moreover, the distribution of showers is sporadic, and minimum temperatures on calm mornings vary from place to place. Climatic data for West Point, in southern Cuming County, and Lyons, in neighboring Burt County, are representative of general conditions in the area (see tables 9 and 10).

During autumn, winter, and early spring, precipitation generally is well distributed and accumulates at a slow rate. During late spring and summer, however, the main sources of precipitation are showers and thunderstorms. Occasional thunderstorms are severe and produce torrential rains, large hail, and damaging

[8] By MORRIS S. WEBB, climatologist for Nebraska, National Weather Service, U.S. Department of Commerce.

TABLE 10.—*Probabilities of specified temperatures in spring and in fall*

[Data for West Point, during 1921–70. Temperatures measured in a standard National Weather Service thermometer shelter at a height of about 5 feet above ground and in a representative exposure. Lower temperatures will exist at times nearer the ground and in local areas subject to extreme air drainage on calm nights]

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
Spring:					
1 year in 10 later than	April 7	April 16	April 24	May 6	May 18
2 years in 10 later than	April 1	April 10	April 18	May 1	May 12
5 years in 10 later than	March 22	March 31	April 8	April 20	May 1
Fall:					
1 year in 10 earlier than	October 27	October 21	October 12	October 2	September 24
2 years in 10 earlier than	November 2	October 27	October 17	October 7	September 29
5 years in 10 earlier than	November 12	November 5	October 27	October 16	October 9

winds. Tornadoes occur infrequently. Rainfalls that equal or exceed 1.0 inch in 30 minutes, 1.3 inches in 1 hour, 1.6 inches in 3 hours, and 2.1 inches in 12 hours can be expected to occur about once a year. Rainfall in a 24-hour period can be expected to be 2.3 inches or more once a year, 2.8 inches or more once in 2 years, and 5.1 inches or more once in 25 years.

The annual precipitation averages 28.3 inches (see table 9). Normally about three-fourths of this amount falls in the period April through September, during which the potential for soil erosion is relatively high. In an average year, the precipitation is 0.01 inch or more on 92 days, 0.10 inch or more on 52 days, and 0.50 inch or more on 19 days.

During the planting season, dry topsoil and ample subsoil moisture are desirable, but variations from these conditions are frequent. The optimum rainfall for growing corn is 1 inch or more a week. The chance of receiving this amount of moisture is 40 percent in June but only 25 percent late in July and in August.

The annual snowfall averages about 34 inches and accounts for about 12 percent of the yearly precipitation. The first snowfall of 1 inch or more normally occurs late in November. Strong northerly wind frequently whips the snow into drifts.

Recorded temperature extremes at West Point range from −38° F on January 12, 1912, to 113° on July 25, 1936. The temperature falls to 32° or lower an average of 155 days a year and rises to 90° or higher (too high for optimum corn growth) 40 days a year. The average frost-free season lasts 160 days. The probabilities of specified temperatures in spring and in fall are shown in table 10.

Annual evaporation from small lakes and farm ponds averages 42 inches. Approximately 77 percent of the total annual evaporation occurs between May 1 and October 31.

Water Supply

Water is an important natural resource in the county. Wells provide most of the water for domestic and livestock use. Farm ponds, dug ponds, and streams supplement the supply for cattle and sheep.

In the uplands, an adequate supply of water generally can be obtained from sand and gravel in the glacial drift and from sandstone of the Dakota Formation. The water is hard but is of acceptable quality. That from the sandstone has a higher iron content than that from the drift.

Water of good quality and in sufficient quantities for domestic and livestock uses can be obtained from sand and gravel in the alluvium of Logan Creek. A plentiful supply for urban and industrial uses can be obtained from alluvial sand and gravel underlying the Elkhorn River valley. This water contains some sulfate and has a high content of iron and manganese. It is hard and is filtered for urban and industrial uses.

In places, sufficient water of suitable quality for irrigation can be pumped from wells. In 1971, 52 irrigation wells were scattered throughout the county and 7,400 acres was under irrigation. Generally, crops are irrigated only in dry years. At sites where new irrigation wells are desired, test holes should be drilled to determine whether a dependable supply of water is available.

Native Vegetation

The composition of much of the plant cover in Cuming County has been altered by man through his use and management of the soils. Native grasses remain in only small areas. Native trees grow on the bluffs near the Elkhorn River valley, on hillsides near streams, and near stream channels on bottom lands.

On the uplands, the principal native grasses are big bluestem, indiangrass, switchgrass, Canada wildrye, little bluestem, prairie dropseed, porcupinegrass, and plains muhly. On the drier and steeper slopes, native grasses include side-oats grama, little bluestem, and green needlegrass. On the bottom lands, they consist primarily of prairie cordgrass, switchgrass, reed canarygrass, Canada wildrye, and indiangrass.

The native vegetation on the bluffs and on hillsides near streams consists mostly of trees, principally green ash, hackberry, bur oak, American elm, and Russian mulberry. Native trees along streams include eastern cottonwood, white willow, green ash, and maple.

Natural Resources

In addition to surface and ground water and native vegetation, valuable natural resources in Cuming County include sand, gravel, and topsoil. A large amount of sand and gravel is pumped from pits excavated in the Elkhorn River valley. The gravel is used locally and in adjoining counties for topdressing rural roads and driveways. Both the sand and gravel are used in concrete for building construction and in blacktopping material for highways, parking lots, and feedlots. The overburden or surface layer removed from sand and gravel pits is used for landfill or topsoil at construction sites.

Trends in Land Use

Farming is the principal means of livelihood in Cuming County, but the trend is towards fewer and larger farms. In 1970, there were 1,410 farms, and these farms averaged 246 acres in size.

Corn and soybeans are the most important crops in the county, and the acreage in these crops has increased from 1964 through 1970. In this period, the acreage of small grain decreased and that of alfalfa remained nearly constant. Most of these crops were produced without irrigation. Center pivot irrigation was initiated in 1970, and six of these sprinkler systems were operating in 1972.

Feeding beef cattle has become an increasingly important business in the county, and from 1964 through 1970, the amount of corn raised for silage has increased. In this period, hog production increased, but the number of milk cows and sheep decreased. In 1970 there were 305,100 cattle being fattened on grain feed and there were 5,050 milk cows, 157,000 hogs, and 2,800 sheep. The number of laying hens decreased from 266,700 in 1966 to 183,720 in 1970.

Industry, Transportation, and Services

Most of the industries in Cuming County are related to agriculture. Beef processing is the largest industry. Two beef processing plants buy and slaughter cattle within the county. West Point has a sales ring where livestock is sold at auction to beef processors or to commercial hog markets. Some livestock is trucked to markets in Omaha and Sioux City, which are in nearby counties.

Grain elevators, feed mills, fertilizer distribution plants, and alfalfa mills are important agriculture-related enterprises that operate in the county. Others include gravel pits and concrete plants.

Transportation facilities in Cuming County include paved Federal and State highways. U.S. Highway 275 follows the Elkhorn River. State Highways 32 and 51 cross the county in an east-west direction, and State Highway 9 crosses the county in a north-south direction. Township and county roads are on most section lines. Most of these roads have gravel surfaces, but some are blacktopped.

The only railroad follows the Elkhorn River, serving West Point, Beemer, and Wisner. Goods and supplies are transported mostly by the several freight and livestock trucklines in the county. No commercial airlines service the county, but four private landing strips can accommodate small aircraft.

Utilities are provided throughout the county by natural gas, electric, and telephone companies. Grade schools in each town and in rural school districts offer elementary education, and five high schools offer secondary education. Churches of various faiths are scattered throughout the county.

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Glossary

Acid soil. Generally, a soil that is acid throughout most or all of the depth that plant roots penetrate. Commonly, only the plow layer or some other specific layer or horizon is designated as acid. Practically, an acid soil is one that has a pH value less than 6.6; precisely, a soil with a pH value less than 7.0.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tilling or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity. The capacity of soils to hold water available for use by most plants. It commonly is defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It generally is expressed as inches of water per inch of soil. In this report, the classes of available water capacity for a 60-inch profile, or to a limiting layer, are as follows:

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 or more

Blowout. An excavation produced by wind action in loose soil, usually sand.

Bottom land. Low land formed by alluvial deposits. It occurs along streams and may or may not be partially or totally flooded.

Buried soil. A developed soil, once exposed but now overlain by another soil more recently formed.

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.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Concave slope. A slope that is rounded inward, as the inside of a bowl.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to the terrace grade.

Convex slope. A slope that is rounded outward, as the outside of a bowl.

Depth, soil. Total thickness of weathered soil material over bedrock or mixed sand and gravel. In this report, the classes of soil depth are as follows:

	Inches
Very shallow	0 to 10
Shallow	10 to 20
Moderately deep	20 to 40
Deep	40 or more

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

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.

Dryfarming. Production of crops that require some tillage in a subhumid or semiarid region, without irrigation. Usually involves use of periods of fallow, during which time enough moisture accumulates in the soil to allow production of a cultivated crop.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before planting cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has been allowed to drain away; the moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity*, or *capillary capacity.*

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Forage. Plant material that can be used as feed by animals; it may be grazed or cut for hay.

Friability. Term for the ease with which soil crumbles. A friable soil is one that crumbles easily.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Glacial drift (geology). Rock material transported by glacial ice and then deposited; also includes the assorted and unassorted materials deposited by streams flowing from glaciers.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, and covered by grass for protection against erosion; used to conduct surface water away from cropland.

Green manure. A crop grown to be turned under at an early stage of maturity, or soon after maturity, for purpose of improving the soil.

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:

A horizon.—The mineral horizon at the surface. 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.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Landscape. All the characteristics that distinguish a certain kind of area on the earth's surface and give it a distinguishing pattern, in contrast to other kinds of areas. Any one kind of soil is said to have a characteristic natural landscape, and under different uses it has one or more characteristic cultural landscapes.

Leached soil. A soil from which most of the soluble material has been removed from the entire profile or has been removed from one part of the profile and has accumulated in another part.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Legume. A member of the legume, or pulse, family (Leguminosae). One of the most important and widely distributed plant families. Includes many valuable forage species, such as peas, beans, peanuts, alfalfa, sweet clover, lespedeza, vetch, and kudzu. Practically all legumes are nitrogen-fixing plants, and many of the herbaceous species are used as cover and green-manure crops. Even some of the legumes that have no forage value (crotalaria and some lupines) are used for soil improvement. Other legumes are locust, honeylocust, redbud, mimosa, wisteria, and many tropical plants.

Light soil. A term used for sandy, or coarse-textured, soil.

Lime. Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soils. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

Loam. A soil consisting of a friable mixture of varying proportions of clay, sand, and organic matter.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mature soil. Any soil with well-developed soil horizons having characteristics produced by the natural processes of soil formation and in near equilibrium with its present environment.

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.

Mulch. A natural or artificially applied layer of plant residue or other material on the surface of the soil. Mulches are generally used to help conserve moisture, control temperature, prevent surface compaction or crusting, reduce runoff and erosion, improve soil structure, or control weeds. Common mulching materials are wood chips, plant residue, sawdust, and compost.

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.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition. In this report, the organic-matter content is rated according to the percentage of organic material in the upper 10 inches of soil after the mixed soil and organic material are put through a 2-mm sieve. The ratings are as follows:

	Percent
Very low	Less than 0.5
Low	0.5—1.0
Moderately low	1.0—2.0
Moderate	2.0—4.0
High	More than 4.0

Parent material. The disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability, soil. The quality of a saturated soil that enables water or air to move through it. In this publication, permeability applies to that part of the soil below the Ap or equivalent layer, and above a depth of 60 inches, or to bedrock that occurs at a shallower depth. Where there is a change of two or more permeability classes within a short vertical distance, the classes and depths are stated. Classes of soil permeability in inches of water per hour are as follows:

	Inches per hour
Very slow	0.06 or less
Slow	0.06 to 0.2
Moderately slow	0.2 to 0.6
Moderate	0.6 to 2.0
Moderately rapid	2.0 to 6.0
Rapid	6.0 to 20.0
Very rapid	20.0 or more

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Piping. Subsurface passageways or pipes caused by dislodging and transporting of soil particles by uncontrolled flowing water. Process occurs in only some kinds of soils but can lead to failure of a hydraulic structure.

Plastic (soil consistence). Capable of being deformed without being broken.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Plow layer. The soil ordinarily moved in tillage; equivalent to surface soil.

Plowpan. A compacted layer formed in the soil immediately below the plow layer.

Profile, soil. A vertical section of the soil through all of its horizons and extending into the parent material.

Puddled soil. A soil that is dense, massive, and without regular structure because it has been artificially compacted when wet. Commonly, a puddled soil is a clayey soil that has been tilled when wet.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing livestock; includes land on which there are some forest trees.

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

Relief. The elevations or inequalities of a land surface, considered collectively.

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 groundwater runoff or seepage flow from ground water. In this report, the term "runoff" is used to mean "surface runoff."

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sandy soils. A broad term for soils of the sand and loamy sand classes: soil material with more than 70 percent sand and less than 15 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the profile.

Shrink-swell potential (engineering). Amount that a soil will expand when wet or contract when dry. Indicates kinds of clay in soil.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slickspots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium or alkali.

Slope. Deviation of a surface from the horizontal, expressed as a percentage. In this report, the following slope classes are recognized:

	Percent
Nearly level	0 to 1
Very gently sloping	1 to 3
Gently sloping	2 or 3 to 6
Moderately sloping or rolling	6 to 11
Moderately steep	11 to 15
Steep	15 to 30

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

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.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons: those inherited from the parent material are called strata.

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 primary forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subgrade (engineering). The substratum, consisting of in-place material or fill material, that is prepared for highway construction; does not include stabilized base course or actual paving material.

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 layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. In this report, the A horizon.

Terrace (engineering). An embankment, or ridge, constructed across sloping soils on the contour at a slight angle to the contour. The terrace intercepts surplus 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 (geology). An old alluvial plain, ordinarily flat or undulating, bordering a stream, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow.

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, silty 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."

Till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glaciers.

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

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.

Transition layer. A layer somewhat resembling two different horizons of a soil and genetically related to them. In this report, the AC horizon.

Underlying material. Generally, weathered soil material immediately beneath the solum. In this report, the C horizon of a soil.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

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.

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

Windbreak. Any shelter that protects from the wind. A vegetative windbreak is a strip of closely spaced trees or shrubs that is planted primarily to deflect wind currents and thereby reduce soil blowing, control snow drifting, conserve moisture, and protect crops, livestock, and buildings.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Information about the use and management of each soil is given in the description of the capability unit and windbreak suitability group to which it is assigned. Other information is given in tables as follows:

Acreage and extent, table 1, page 9.
Predicted yields, table 2, page 37.

Engineering uses of the soils, table 5, page 44, table 6, page 48, and table 7, page 58.

Map symbol	Mapping unit	Page	Capability unit		Windbreak suitability group	
			Symbol	Page	Number	Page
Be	Belfore silty clay loam, 0 to 2 percent slopes	10	I-1	29	4	40
Bf	Belfore silty clay loam, terrace, 0 to 2 percent slopes	10	I-1	29	1	40
Bo	Boel loam, 0 to 2 percent slopes	11	IIIw-4	33	2	40
Ca	Calco silty clay loam, 0 to 2 percent slopes	12	IIw-4	30	2	40
Cb	Calco silty clay loam, wet, 0 to 2 percent slopes	12	Vw-7	34	6	40
Cd	Cass fine sandy loam, 0 to 2 percent slopes	12	IIs-6	30	3	40
Ce	Colo silty clay loam, 0 to 2 percent slopes	13	IIw-4	30	2	40
CfD2	Crofton silt loam, 6 to 11 percent slopes, eroded	14	IVe-9	34	5	40
CfE2	Crofton silt loam, 11 to 15 percent slopes, eroded	14	IVe-9	34	5	40
CfF	Crofton silt loam, 15 to 30 percent slopes	14	VIe-9	35	10	41
In	Inavale loamy fine sand, 0 to 2 percent slopes	15	IVe-5	33	3	40
InC	Inavale loamy fine sand, 2 to 6 percent slopes	15	VIe-5	34	3	40
JuC	Judson silty clay loam, 2 to 6 percent slopes	16	IIe-1	30	4	40
Ke	Kennebec silt loam, 0 to 2 percent slopes	16	I-1	29	1	40
Ko	Kennebec silt loam, overwash, 0 to 2 percent slopes	16	IIw-3	30	1	40
La	Lamo silty clay loam, 0 to 2 percent slopes	17	IIw-4	30	2	40
Lb	Lamo silty clay loam, wet, 0 to 1 percent slopes	17	Vw-7	34	6	40
Lc	Lamo-Slickspots complex, 0 to 2 percent slopes	17	IVs-1	34	--	--
	Lamo soil	--	------	--	2	40
	Slickspots part	--	------	--	10	41
LeC	Leisy fine sandy loam, 2 to 6 percent slopes	18	IIIe-3	32	3	40
LeD	Leisy fine sandy loam, 6 to 9 percent slopes	18	IVe-3	33	3	40
LfC	Leisy loam, 2 to 6 percent slopes	19	IIe-1	30	4	40
Lh	Leshara silt loam, 0 to 2 percent slopes	19	IIw-4	30	2	40
Mh	Marsh	19	VIIIw-7	35	10	41
MoC	Moody silty clay loam, 2 to 6 percent slopes	21	IIe-1	30	4	40
MoC2	Moody silty clay loam, 2 to 6 percent slopes, eroded	21	IIe-1	30	4	40
MoD	Moody silty clay loam, 6 to 11 percent slopes	21	IIIe-1	32	4	40
MoD2	Moody silty clay loam, 6 to 11 percent slopes, eroded	21	IIIe-8	32	4	40
NoD	Nora silty clay loam, 6 to 11 percent slopes	22	IIIe-1	32	4	40
NoD2	Nora silty clay loam, 6 to 11 percent slopes, eroded	22	IIIe-8	32	4	40
NoE	Nora silty clay loam, 11 to 15 percent slopes	23	IVe-1	33	4	40
NoE2	Nora silty clay loam, 11 to 15 percent slopes, eroded	23	IVe-8	34	4	40
Sa	Sandy alluvial land	23	VIw-7	35	10	41
Sy	Silty alluvial land	23	VIw-7	35	10	41
TvB	Thurman and Valentine loamy fine sands, 0 to 3 percent slopes	24	IIIe-5	32	3	40
TvC	Thurman and Valentine loamy fine sands, 3 to 6 percent slopes	24	IVe-5	33	--	--
	Thurman soil	--	------	--	3	40
	Valentine soil	--	------	--	7	40
TvD	Thurman and Valentine loamy fine sands, 6 to 11 percent slopes	25	VIe-5	34	7	40
VaD	Valentine loamy fine sand, 3 to 10 percent slopes	25	VIe-5	34	7	40
Wm	Wann loam, 0 to 2 percent slopes	26	IIw-4	30	2	40
Zo	Zook silty clay loam, 0 to 2 percent slopes	26	IIw-4	30	2	40
Zw	Zook silty clay, 0 to 2 percent slopes	27	IIIw-1	32	2	40

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