Seward County, Nebraska

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

Issued June 1974

Major fieldwork for this soil survey was done in the period 1960-67. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1967. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is a part of the technical assistance furnished to the Upper Big Blue and the Lower Platte South Natural Resource District.

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

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

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

Finding and Using Information

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

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

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

Foresters and others can refer to the section "Management of Soils for 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 "Management of the Soils for Wildlife and Recreation."

Ranchers and others can find, under "Management of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of homesites, industrial sites, schools, and parks in the section "Engineering Uses of the Soils."

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

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

Newcomers in Seward County will 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: Soil and water conservation on Hastings soil in western Seward County. (Courtesy of Richard Hufnagle, photographer.)

U.S. GOVERNMENT PRINTING OFFICE: 1974

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

Contents

	Page
How this survey was made	1
General soil map	2
1. Hastings-Fillmore-Butler association	2
2. Hastings-Geary association	3
3. Hobbs-Hall association	4
4. Hastings-Wymore association	5
5. Pawnee-Sharpsburg association	6
6. Burchard-Steinauer association	7
Descriptions of the soils	8
Breaks-alluvial land complex	9
Burchard series	10
Butler series	11
Crete series	12
Fillmore series	13
Geary series	14
Hall series	16
Hastings series	18
Hobbs series	21
Hord series	22
Lamo series	23
Longford series	24
Marsh	24
Meadin series	25
Morrill series	26
Pawnee series	26
Rough broken land, loess	28
Rough broken land, till	29
Scott series	29
Sharpsburg series	30
Shelby series	32
Silty alluvial land	33
Slickspots	33
Steinauer series	33
Wet alluvial land	35
Wymore series	35
Use and management of the soils	36
Management of the soils for crops	36
Capability grouping	37
Predicted yields	47
Use and management of the soils—Con.	
Management of the soils for range	50
Range sites and condition classes	50
Descriptions of range sites	51
Management of the soils for windbreaks	52
Kinds of windbreaks	53
Planting of windbreaks	53
Windbreak suitability groups	53
Management of the soils for wildlife and recreation	55
Engineering uses of the soils	57
Engineering classification systems	59
Engineering test data	59
Soil properties significant to engineering	72
Engineering interpretations of the soils	73
Formation and classification of soils	74
Factors of soil formation	75
Parent material	75
Climate	76
Plants and animals	76
Relief	77
Time	77
Classification of soils	77
General nature of the county	78
Settlement, organization, and population	78
Physiography, relief, and drainage	79
Climate	79
Ground water	79
Farming	82
Irrigation	82
Transportation and markets	82
Industry	82
Community, cultural, and recreational facilities	83
Literature cited	83
Glossary	83
Guide to mapping units Following	85

Issued June 1974

SOIL SURVEY OF SEWARD COUNTY, NEBRASKA

BY LOYAL A. QUANDT, SOIL CONSERVATION SERVICE

SOILS SURVEYED BY LOYAL A. QUANDT, MELVIN JAMES, AND KENNETH GOOD, SOIL CONSERVATION SERVICE

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

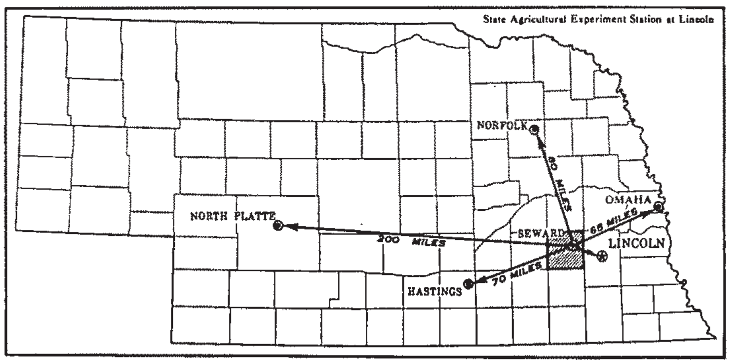

Figure 1.—Location of Seward County in Nebraska.

SEWARD COUNTY is in the southeastern part of Nebraska (fig. 1). It has a land area of 572 square miles, or 366,080 acres. Seward, the county seat and largest town, is near the center of the county. In the western and central parts, loess-mantled plains slope to bottom lands along the Big Blue River and its tributaries. In the eastern part, rolling to steep uplands overlook the Oak Creek and Middle Creek bottom lands and the Big Blue River.

The principal enterprise is farming. About 76 percent of the acreage of the county is cropland, 16 percent is native grass and pasture, and 8 percent is farmsteads, woodland, and urban land. Corn, grain sorghum, wheat, alfalfa, and soybeans are the main crops. Much of the corn and forage is fed to livestock, and the wheat, soybeans, and most of the grain sorghum are grown for sale. There are many irrigated farms in the western and central parts of the county, where water is available from deep wells and flowing streams.

Through the Upper Big Blue and the Lower Platte South Natural Resource Districts, farmers receive technical assistance from the Soil Conservation Service, U.S. Department of Agriculture, in planning and applying soil and water conservation practices on the land.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Seward County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

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

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. Hastings and Wymore, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Crete silt loam, 1 to 3 percent slopes, is one of several phases within the Crete series.

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

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

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

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

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

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

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

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

General Soil Map

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

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

The soil associations in Seward County are discussed in the following pages. Unless otherwise stated, the terms for texture used in the title for each association apply to the surface layer.

1. Hastings-Fillmore-Butler association

Nearly level to gently sloping soils that have a silty surface layer and a loamy to clayey subsoil; on uplands mantled with loess and in depressions

This association consists of uplands mantled with loess and of many depressions where water ponds after rains. Most areas are nearly level or very gently sloping, but a few small areas on side slopes of drainageways are gently sloping (fig. 2).

This association covers an area of 144,065 acres, or about 39 percent of the county. Hastings soils make up about 72 percent of this association, Fillmore soils, 14 percent, and Butler soils, 9 percent. The remaining 5 percent is minor soils.

Hastings soils are well drained and nearly level to gently sloping. Their surface layer is thick, dark-gray silt loam or silty clay loam. The subsoil is dark grayish-brown silty clay loam that has moderately slow permeability. The underlying material is pale-brown silt loam.

Fillmore soils are in shallow depressions that are ponded for short periods. They have a gray silt loam surface layer and a light-gray silt loam subsurface layer. The subsoil is a dense, dark-gray claypan. The underlying material is dark grayish-brown silt loam.

Butler soils are nearly level and mainly border depressions of the uplands. Their surface layer is dark-gray silt loam, and the subsurface layer is thin and gray. The subsoil is very dark gray clay that has strong blocky structure. The underlying material is light brownish-gray silt loam.

Minor soils of this association are mainly in the Crete and Scott series. Crete soils are nearly level and are slightly higher on the landscape than the Butler soils but not so high as the Hastings soils. The Scott soil is in large depressions that are frequently ponded.

Most of the acreage in this association is cultivated, and many of the nearly level soils are irrigated. Corn and grain sorghum are the main crops, but wheat, soybeans, and alfalfa are grown in small areas. Maintaining fertility is a management concern in irrigated areas and water erosion is a hazard on the gently sloping soils that are irrigated or dryfarmed. In some areas better surface drainage is needed to reduce ponding.

On most of the farms in this association grain is grown for cash, but on a few farms most of the grain is fed to beef and dairy cattle. The potential for growing a wider variety of crops and for continued irrigation development is high, and crops suited to the climate can be grown if markets become available. Good gravel roads are on most of the section lines.

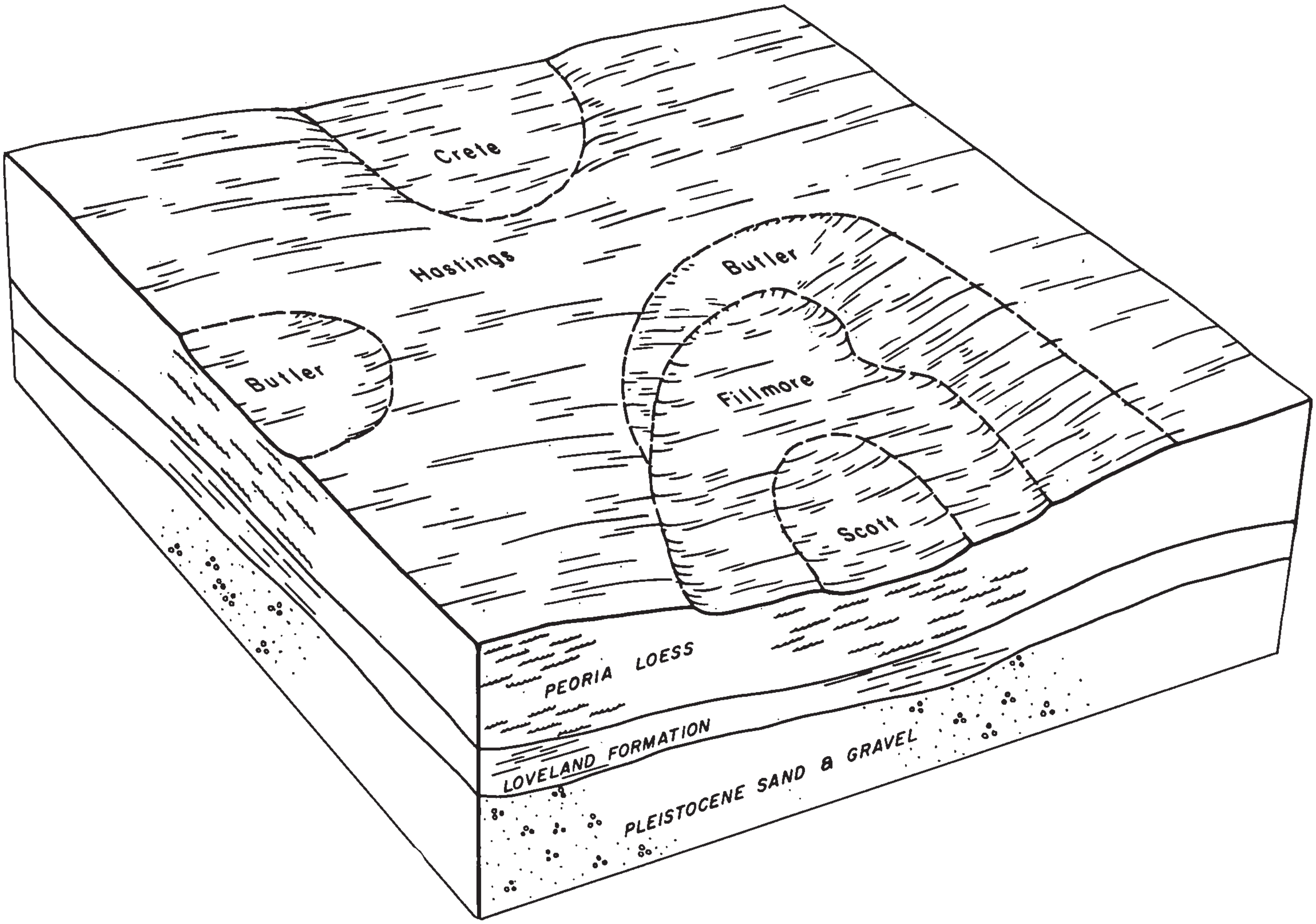

Figure 2.—Typical pattern of soils and underlying material in association 1.

2. *Hastings-Geary association*

Moderately sloping to steep soils that are silty throughout; on uplands mantled with loess

In this association are soils on uplands mantled with loess. Moderately sloping and strongly sloping soils are along the minor drainageways. Moderately steep and steep soils of the uplands border the valley of the Big Blue River and its tributaries (fig. 3).

This association covers an area of 56,015 acres, or about 15 percent of the county. Hastings soils make up about 71 percent of this association, and Geary soils, 18 percent. The remaining 11 percent is minor soils.

Hastings soils are mainly on side slopes of the smaller tributaries and along the upper part of slopes that border stream valleys in the western and central parts of the county. Their surface layer is very dark brown silt loam or silty clay loam. The subsoil is dark grayish-brown silty clay loam. The underlying material is silt loam. The severely eroded Hastings soils are lighter in color than the uneroded ones, and they are lower in fertility and in content of organic matter.

Geary soils are mainly on the lower parts of side slopes that border stream valleys. Their surface layer is very dark brown silty clay loam. The subsoil is dark-brown to reddish-brown loess of the Loveland Formation. The severely eroded Geary soils have a lighter colored surface layer than the uneroded ones.

Minor soils of this association are in the Meadin series. The land types Breaks-Alluvial land complex and Rough broken land, loess, are also in this association. They are moderately steep to very steep and on breaks that border drainageways and tributaries. Also in this association are narrow strips of soils on bottom lands that are occasionally flooded.

The soils in this association have a medium acid or slightly acid surface layer, but their subsoil and underlying material range from neutral to mildly alkaline. Runoff is medium to rapid. Most areas are severely eroded, and here fertility and content of organic matter are low.

About half of the acreage of this association is in tame pasture and native grasses, and grazing and mowing are needed to maintain a good cover of plants. The other half

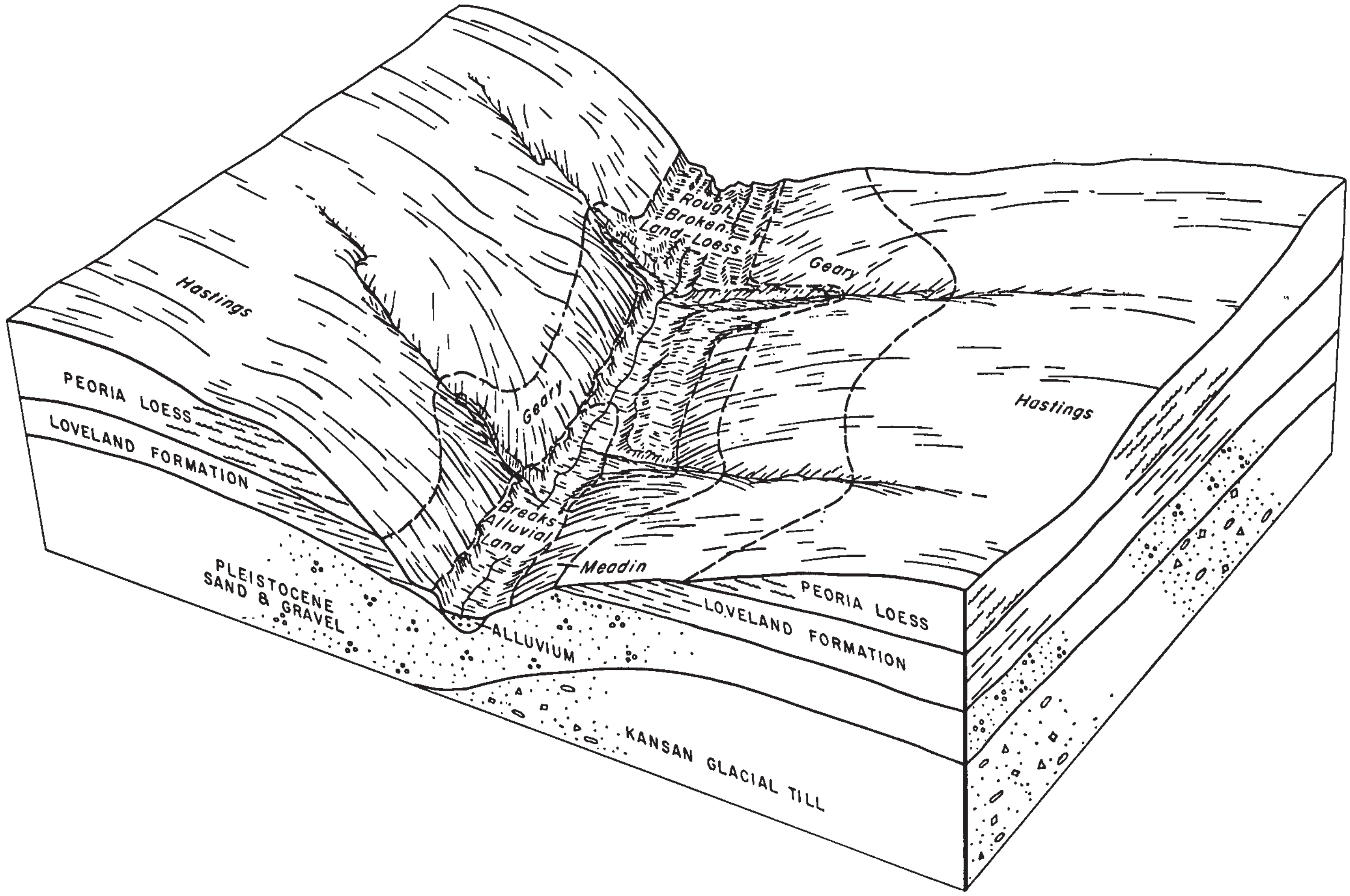

***Figure 3.*—Typical pattern of soils and underlying material in association 2.**

of this association, which consists mainly of moderately sloping soils, is cultivated. Grain sorghum, wheat, and alfalfa are the major crops. The moderate to strong slopes and many small gullies limit the use of large machinery. The main concern of management on cultivated fields is controlling sheet and gully erosion. Practices that help to maintain tilth, conserve moisture, and reduce erosion are needed in all areas.

Most of the farms of this association are used both for growing cash-grain crops and for the raising of livestock. The areas have potential for improving the pasture and livestock program. Most section lines have good gravel roads, but a few have unimproved roads or trails.

3. *Hobbs-Hall association*

Nearly level soils that are silty throughout; on bottom lands and stream terraces

This association consists of soils on bottom lands and stream terraces of the major valleys and on adjacent valley foot slopes that border uplands (fig. 4). These soils are mainly nearly level, but in some areas they are gently sloping.

This association covers an area of 71,000 acres, or about 20 percent of the county. Hobbs soils make up about 56 percent of this association, and Hall soils, 10 percent. The remaining 34 percent consists of minor soils and land types.

Hobbs soils are the most extensive soils in this association and are on the higher parts of the bottom lands and on foot slopes. Their surface layer is thick, grayish-brown silt loam. The underlying material ranges from silt loam to silty clay loam. Depth to the water table in these soils ranges from 6 to 15 feet.

Hall soils are on stream terraces. Their surface layer is dark-gray silt loam or silty clay loam. The subsoil is dark grayish-brown silty clay loam that is moderately slowly permeable. The underlying material is light-gray silt loam.

Minor soils of this association are mainly in the Butler, Crete, Hord, and Lamo series. The land types Silty alluvial land and Wet alluvial land are also in this association. The Butler, Crete, and Hord soils are on stream terraces, and the somewhat poorly drained Lamo soils are on bottom lands. Silty alluvial land is along drainageways. It consists of deep channels, of oxbows, and of narrow level areas that are frequently flooded and the adjacent steep banks. Wet alluvial land is in pockets or depressions on bottom lands, where the water table is high. It is wet throughout the year.

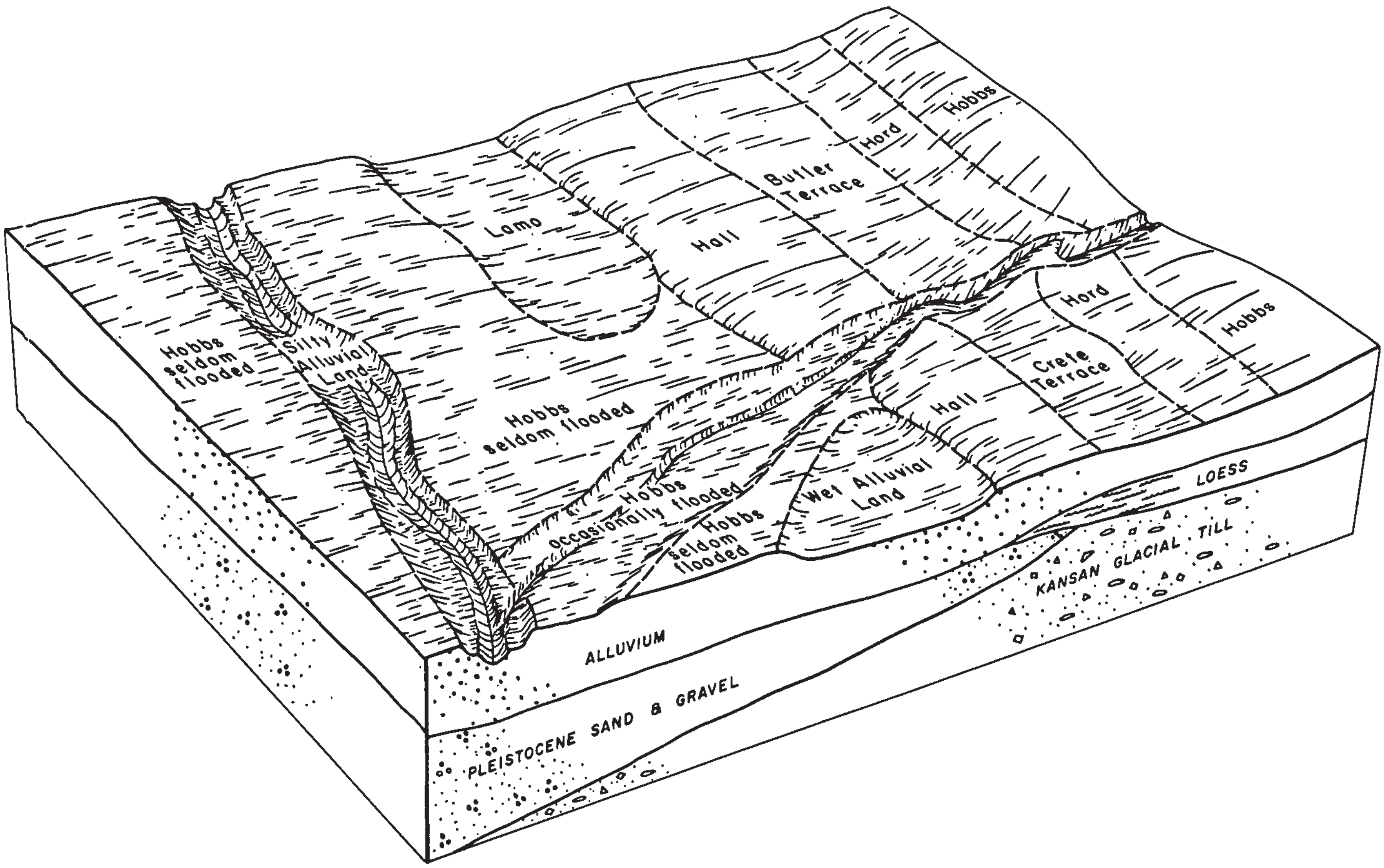

***Figure 4.*—Typical pattern of soils and underlying material in association 3.**

The soils of this association are used for cultivated crops and for grazing. Drainage and flood control practices are needed to help reduce damage to crops in flooded areas. Soils on stream terraces, foot slopes, and bottom lands that are seldom flooded are used mostly for grazing. Corn, grain sorghum, soybeans, and alfalfa are the major crops. Some areas are irrigated with water pumped from creeks and rivers. The major concern of management in this association is wetness that limits crop growth. The main concerns in irrigated areas are maintaining fertility and managing water.

Most of the farms in this association are used both for the growing of crops and the raising of livestock. The acreage in crops can be increased by draining the wet lands. Irrigation can be developed in some places. Good roads are on most section lines.

4. Hastings-Wymore association

Nearly level to moderately sloping soils that have a silty surface layer and silty or clayey subsoil; on uplands mantled with loess

In this association are nearly level to moderately sloping soils on uplands mantled with loess. The areas are bordered by the Big Blue River on the west and by till-mantled uplands on the east (fig. 5). Only a few depressions are in this association.

This association covers 40,000 acres, or about 11 percent of the county. Hastings soils make up about 80 percent of the association, and Wymore soils, 8 percent. The remaining 12 percent is minor soils.

Hastings soils are nearly level to moderately sloping. The surface layer generally is dark-gray silt loam or silty clay loam, but it is lighter colored in severely eroded areas. The subsoil is dark grayish-brown silty clay loam, and the underlying material is pale-brown silt loam. The Hastings soils in this association have a slightly finer textured subsoil than the Hastings soils in the western part of the county.

Wymore soils are mainly in the south and central parts of this association. They formed in a thin mantle of loess that overlies glacial till and are nearly level to moderately sloping. These soils have a surface layer of gray silty clay loam. The subsoil is dark grayish-brown silty clay. The underlying material is light-gray silt loam that contains small amounts of lime.

Minor soils of this association are in the Butler, Hobbs, and Longford series. Butler soils have a claypan and are on flats. Hobbs soils are in the bottoms of narrow drainageways on uplands. Longford soils formed in light-brown or reddish-brown loess, and they are on the lower part of side slopes of drainageways.

Corn, sorghum, wheat, alfalfa, and soybeans grow well on soils of this association. A few areas are irrigated, but the wells are at a considerable depth and contain a limited amount of water. Controlling erosion and conserving

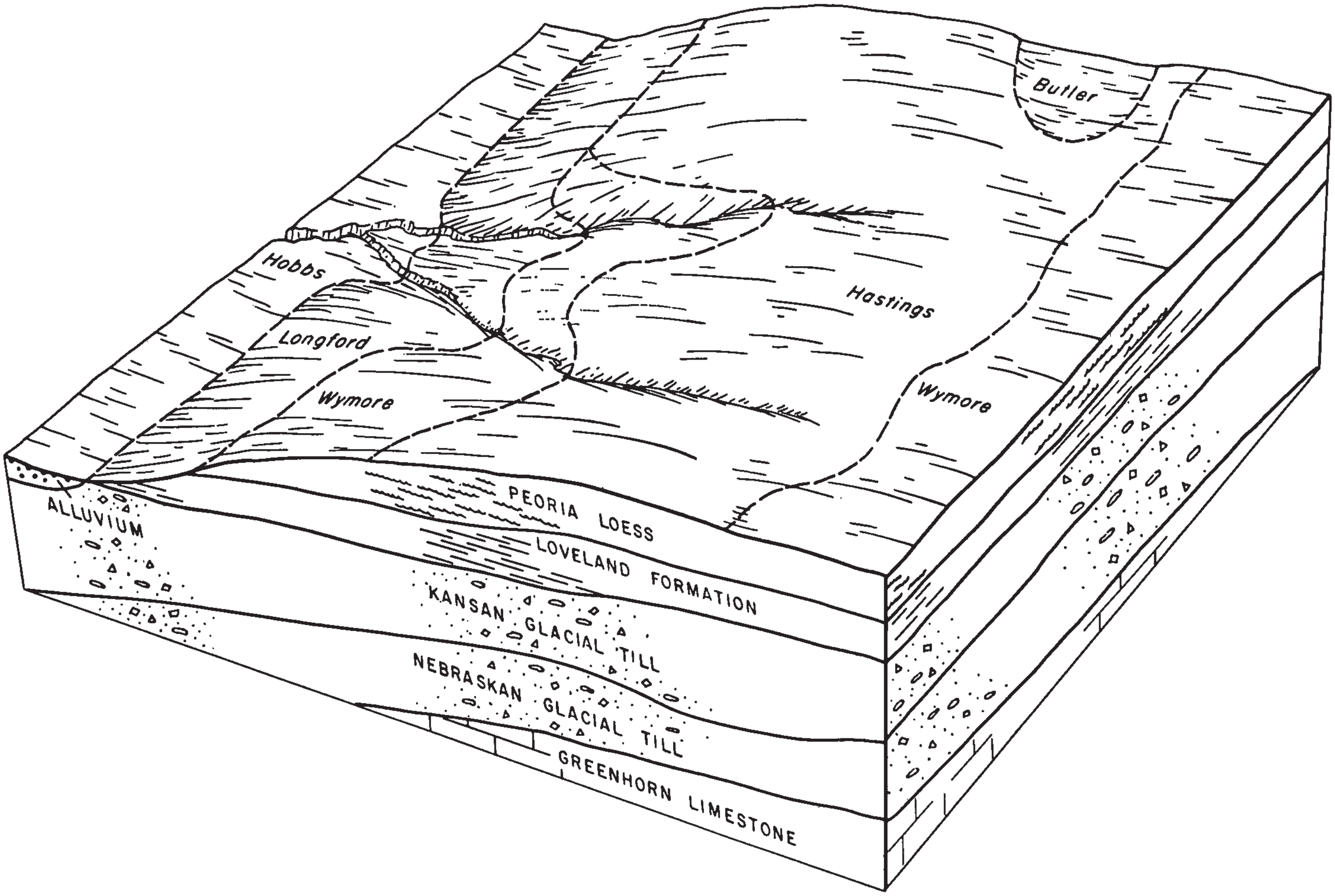

***Figure 5.*—Typical pattern of soils and underlying material in association 4.**

water are the major concerns of management. In irrigated areas maintaining fertility and controlling water are also concerns.

Most of the farms of this association are used for cash grain crops. On some of the farms, however, dairying and the raising of livestock are the main enterprises. Markets for all farm products are in Seward and nearby Lincoln. Crop growth can be increased if irrigation is further developed. Good gravel roads are on all section lines.

5. *Pawnee-Sharpsburg association*

Gently sloping to moderately sloping soils that have a loamy or silty surface layer and clayey to silty subsoil; on uplands mantled with loess and glacial till

This association consists of soils on uplands that have a mantle of glacial till and loess. The loess is mainly on the high ridgetops and the upper parts of the side slopes of drainageways. The glacial till is on the lower part of the side slopes and on some of the lower lying ridges. The soils in this association are mainly gently sloping to moderately sloping, but some are steep. Gullies cut areas where the drainage pattern is deeply entrenched (fig. 6). Many trees grow along the drainageways in this association.

This association covers 30,000 acres or about 8 percent of the county. Pawnee soils make up about 50 percent of the association, and Sharpsburg soils, 46 percent. The remaining 4 percent is minor soils.

Pawnee soils formed in glacial till. The surface layer is dark-gray and dark grayish-brown clay loam. The subsoil is grayish-brown clay in the upper part and brown heavy clay loam in the lower part. The underlying material is yellowish-brown clay loam that contains pockets and seams of lime.

Sharpsburg soils formed in loess. Their surface layer is dark-gray silty clay loam. The subsoil is dark-brown and brown silty clay loam, and the underlying material is pale-brown silt loam.

Minor soils of this association are mostly in the Hobbs and Wymore series. Also in this association is the land type Rough broken land, till. Hobbs soils are on the bottom of upland drainageways. Wymore soils formed in a thin mantle of loess that overlies glacial till. These soils are on side slopes in the upper parts of the drainageways. Rough broken land, till, is steep and is deeply gullied.

Runoff is medium to rapid on these soils. Available water capacity is moderate to high. In severely eroded

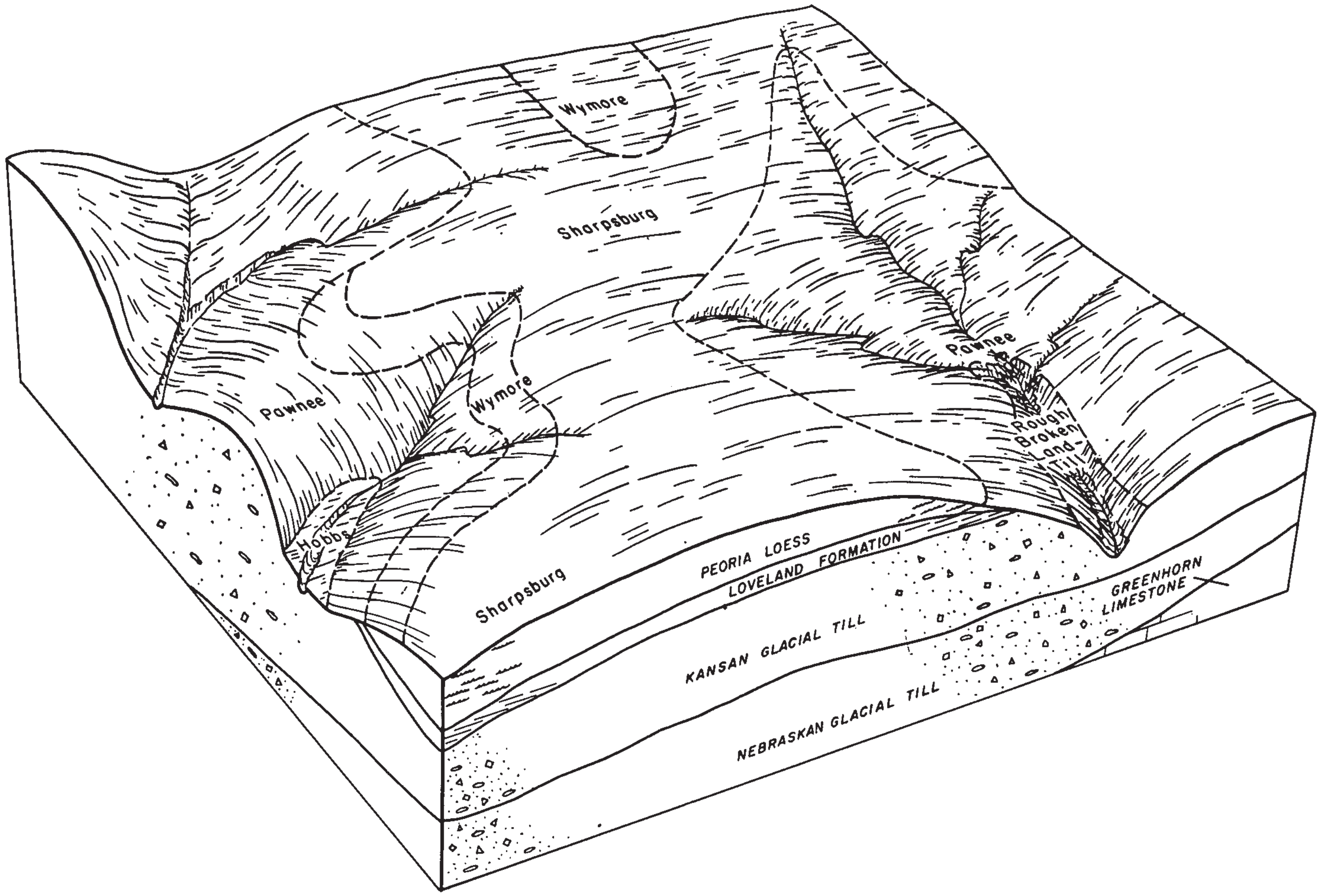

***Figure 6.*—Typical pattern of soils and underlying material in association 5.**

areas these soils are difficult to till because of small gullies. The main concerns of management are maintaining the fertility and the content of organic matter, conserving moisture, and controlling sheet and gully erosion.

About three-fourths of the acreage in this association is cultivated. Most of the farms are used both for growing grain for cash and for the raising of livestock. The main crops are grain sorghum, wheat, and alfalfa, but corn and soybeans also are grown. Many of the severely eroded soils are seeded to perennial grasses, but some of the strongly sloping to steep soils are in native range. The water supply from wells is limited in places, but it generally is adequate for domestic and wildlife use. Gravel roads are on most section lines.

6. Burchard-Steinauer association

Moderately sloping to steep, loamy soils on uplands of glacial till

This association consists of moderately sloping to steep soils on uplands of glacial till (fig. 7). The drainage system is deeply entrenched and is part of the Oak Creek and Middle Creek drainage basin.

This association covers an area of 25,000 acres, or about 7 percent of the county. Burchard soils make up about 40 percent of the association, and Steinauer soils, 39 percent. The remaining 21 percent is minor soils.

Burchard soils are moderately sloping to strongly sloping, and have a few stones on their surface. The surface layer is dark-gray clay loam about 12 inches thick. The subsoil is brown clay loam, and the underlying material is glacial till that contains much lime, some small stones, and a few boulders.

Steinauer soils are moderately sloping to steep, and a few large boulders are scattered over the surface. The surface layer is grayish-brown clay loam that is about 6 inches thick. The underlying material is light brownish-gray and light yellowish-brown glacial till that contains many stains, pockets, and seams of soft lime.

Minor soils of this association are in the Morrill, Pawnee, Sharpsburg, and Shelby series. Also in this association is the land type, Rough broken land, till. Morrill soils generally occupy lower positions on the landscape than Burchard or Steinauer soils and have a reddish-brown subsoil. Sharpsburg soils are on the high ridges that are mantled with loess. Shelby soils are gently sloping to moderately sloping and are mostly on the lower parts of concave slopes. Pawnee soils are on the lower parts of ridgetops. Rough broken land, till, is steep and occupies breaks on till material along minor drainageways of

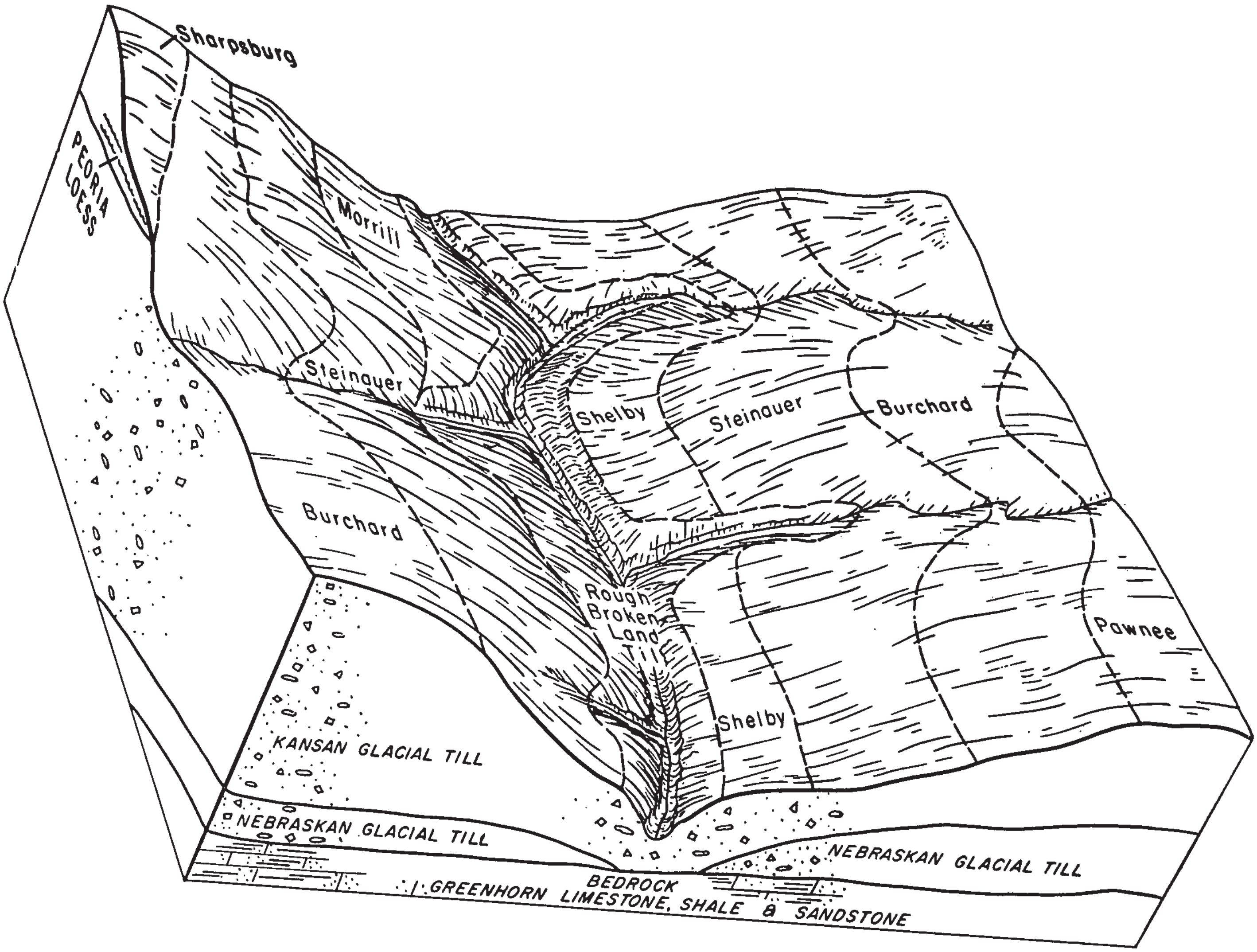

Figure 7.—**Typical pattern of soils and underlying material in association 6.**

the Oak Creek and Middle Creek drainage system. Many trees and shrubs are in these steep areas.

Runoff is rapid on the soils of this association. The content of organic matter is medium to low. Because of the short, irregular slopes, the use of large machinery is limited. Grain sorghum, alfalfa, and wheat are suitable crops for the moderately sloping soils. The main concerns of management are preventing gully and sheet erosion, conserving moisture, and maintaining tilth and fertility. Most of the steeper areas are in native grasses or in pasture of tame grasses.

Most of the farms in this association are used both for growing cash grain crops and for the raising of livestock. In a few areas adequate water for livestock is difficult to obtain. Good gravel roads are on most section lines.

Descriptions of the Soils

In this section the soil series and the mapping units of Seward County are described. The procedure is to describe first each soil series, and then the mapping units in that series. Thus, to get full information on any mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which the unit belongs.

Each series contains a short, nontechnical description of a representative soil profile and a detailed, technical description of the same profile that scientists, engineers, and others can use in making technical interpretations. If the profile of a given mapping unit differs from the representative profile, the differences are stated in the description of the mapping unit, unless they are apparent in the name of the mapping unit. The colors described are for dry soils unless otherwise noted.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Wet alluvial land, for example, does not belong to a soil series; but, nevertheless, it is listed in alphabetical 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, which is at the back of this survey. Listed at the end of each description of a mapping unit is the capability unit, range site, and windbreak suitability group in which the mapping unit has been placed. The page on which each interpretive group is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Many of the terms used in describing the soil series and the mapping units are defined in the Glossary and are described more fully in the Soil Survey Manual (*6*).[1] The approximate acreage and the proportionate extent of the mapping units are shown in table 1.

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (By) consists of steep to very steep breaks and of narrow, nearly level areas of alluvial land along drainageways of the uplands. About 75 percent of the complex is steep excessively drained soil on side slopes of the uplands that has a surface layer of dark-gray to brown silty clay loam and underlying material of pale-brown to yellowish-brown and medium textured to moderately fine textured loess. The remaining 25 percent is nearly level, narrow alluvial land made up of very dark gray, medium-textured sediment that accumulated on the bottom lands of narrow drainageways.

The bottom land is occasionally flooded and has uncrossable, deeply entrenched channels where slopes are steep. Runoff is very rapid on the Breaks part of this complex, and permeability is moderately slow. Gullies and overfalls are common in pastures that are overgrazed.

[1] Italic numbers in parentheses refer to Literature Cited, p. 83.

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

Soil	Acres	Percent
Breaks-Alluvial land complex	5, 201	1. 4
Burchard clay loam, 7 to 12 percent slopes	1, 500	. 4
Burchard clay loam, 7 to 12 percent slopes, eroded	5, 312	1. 5
Burchard-Steinauer clay loams, 12 to 17 percent slopes	2, 344	. 6
Burchard-Steinauer clay loams, 12 to 17 percent slopes, eroded	633	. 2
Butler silt loam	11, 765	3. 2
Butler silt loam, terrace	8, 318	2. 3
Butler-Slickspots complex	388	. 1
Crete silt loam, 0 to 1 percent slopes	2, 975	. 8
Crete silt loam, 1 to 3 percent slopes	1, 939	. 5
Crete silt loam, terrace, 1 to 3 percent slopes	1, 802	. 5
Fillmore silt loam	19, 670	5. 4
Geary silty clay loam, 3 to 7 percent slopes, eroded	380	. 1
Geary silty clay loam, 7 to 12 percent slopes, eroded	3, 959	1. 1
Geary silty clay loam, 7 to 12 percent slopes, severely eroded	2, 963	. 8
Geary silty clay loam, 12 to 31 percent slopes, severely eroded	1, 029	. 3
Hall silt loam, 0 to 1 percent slopes	2, 813	. 8
Hall silt loam, 1 to 3 percent slopes	1, 987	. 5
Hall-Slickspots complex, 1 to 3 percent slopes	1, 227	. 3
Hastings silt loam, 0 to 1 percent slopes	54, 466	15. 0
Hastings silt loam, 1 to 3 percent slopes	41, 288	11. 4
Hastings silty clay loam, 1 to 3 percent slopes, eroded	7, 749	2. 1
Hastings silty clay loam, 3 to 7 percent slopes, eroded	35, 885	9. 8
Hastings silty clay loam, 7 to 12 percent slopes, eroded	13, 389	3. 7
Hastings silty clay loam, 3 to 7 percent slopes, severely eroded	2, 028	. 6
Hastings silty clay loam, 7 to 12 percent slopes, severely eroded	17, 124	4. 7
Hastings silty clay loam, 12 to 17 percent slopes, severely eroded	7, 497	2. 0
Hastings silty clay loam, terrace, 3 to 7 percent slopes, eroded	891	. 2
Hastings soils, 1 to 3 percent slopes, severely eroded	125	([1])
Hobbs silt loam, occasionally flooded	9, 179	2. 5
Hobbs silt loam, 0 to 1 percent slopes	13, 569	3. 7
Hobbs silt loam, 1 to 3 percent slopes	10, 676	2. 9
Hobbs silt loam, 3 to 7 percent slopes	4, 710	1. 3
Hobbs silty clay loam, 0 to 1 percent slopes	2, 265	. 6
Hord silt loam, 0 to 1 percent slopes	1, 143	. 3
Lamo silty clay loam	2, 265	. 6
Longford silty clay loam, 5 to 12 percent slopes, eroded	2, 234	. 6
Marsh	280	([1])
Meadin soils, 7 to 31 percent slopes, eroded	1, 009	. 3
Morrill clay loam, 7 to 12 percent slopes, eroded	643	. 2
Pawnee clay loam, 3 to 7 percent slopes	683	. 2
Pawnee clay loam, 3 to 7 percent slopes, eroded	4, 874	1. 3
Pawnee clay loam, 7 to 12 percent slopes	430	. 1
Pawnee clay loam, 7 to 12 percent slopes, eroded	5, 305	1. 4
Pawnee soils, 3 to 7 percent slopes, severely eroded	439	. 1
Pawnee soils, 7 to 12 percent slopes, severely eroded	3, 896	1. 1
Rough broken land, loess	1, 311	. 4
Rough broken land, till	2, 715	. 7
Scott silt loam	946	. 3
Sharpsburg silty clay loam, 3 to 7 percent slopes, eroded	5, 804	1. 6
Sharpsburg silty clay loam, 3 to 7 percent slopes, severely eroded	724	. 2
Sharpsburg silty clay loam, 7 to 12 percent slopes, eroded	4, 709	1. 3
Sharpsburg silty clay loam, 7 to 12 percent slopes, severely eroded	2, 526	. 7
Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded	442	. 1
Shelby clay loam, 5 to 12 percent slopes, eroded	1, 066	. 3
Shelby clay loam, 7 to 12 percent slopes	541	. 1
Silty alluvial land	10, 598	2. 9
Steinauer clay loam, 7 to 12 percent slopes, eroded	3, 925	1. 1
Steinauer clay loam, 12 to 31 percent slopes	4, 641	1. 3
Steinauer clay loam, 12 to 31 percent slopes, eroded	1, 447	. 4
Wet alluvial land	458	. 1
Wymore silty clay loam, 0 to 1 percent slopes	693	. 2
Wymore silty clay loam, 1 to 3 percent slopes	528	. 1
Wymore silty clay loam, 3 to 7 percent slopes, eroded	815	. 2
Wymore soils, 7 to 9 percent slopes, eroded	339	. 1
Water areas	1, 605	. 4
Total	366, 080	100. 0

[1] Less than 0.1 percent.

This complex is not suitable for crops. The vegetation on the side slopes is mainly tall and mid grasses, though trees grow in places. Similar grasses, tall annual weeds, trees, and woody shrubs grow on the bottom lands. Both parts in capability unit VIe-9, dryland; Breaks is in Silty range site, and Alluvial land is in Silty Overflow range site; both parts in Silty to Clayey windbreak suitability group.

Burchard Series

In the Burchard series are deep, well-drained soils that are moderately sloping to strongly sloping. These soils formed in moderately fine textured, limy glacial till on uplands (fig. 8).

In a representative profile the surface layer is dark-gray to dark grayish-brown clay loam that is about 12 inches thick and contains a few small pebbles and stones. The subsoil is about 17 inches thick. The upper 12 inches of the subsoil is brown clay loam, and the lower 5 inches is pale-brown clay loam that contains much lime. The subsoil also contains many coarse sand grains and a few small pebbles and stones. The underlying material is limy glacial till that is clay loam in texture. It contains a few small to medium pebbles and stones.

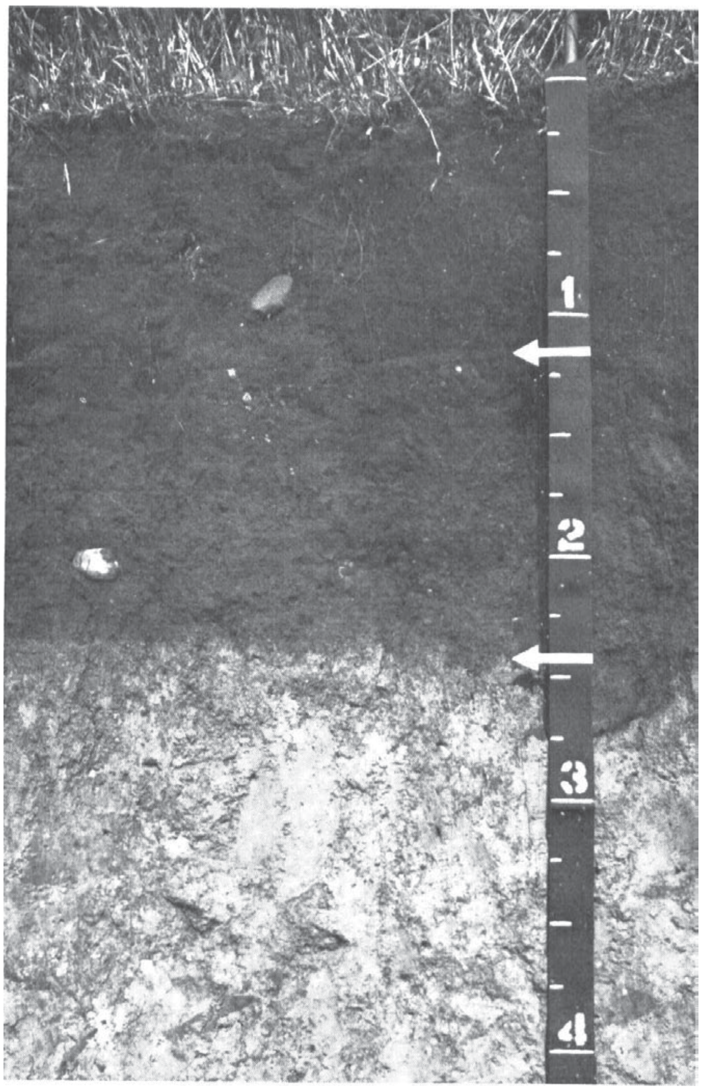

***Figure 8.*—Profile of a Burchard clay loam. This soil formed in limy glacial till and contains a few stones throughout its profile.**

Permeability of the Burchard soils is moderately slow. Available water capacity is high. Runoff is rapid, and if the steeper soils are cultivated they are subject to severe erosion.

Most of the less sloping areas of these soils are cultivated and are dry-farmed. The steeper areas are mapped in complexes with Steinauer soils and are mostly in native and tame grasses.

Representative profile of Burchard clay loam, 7 to 12 percent slopes (in native grasses 400 feet north and 264 feet east of the center of sec. 23, T. 12 N., R. 4 E.):

A11—0 to 7 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; few small pebbles and stones; slightly acid; clear, smooth boundary.

A12—7 to 12 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist; few small pebbles and stones; neutral; clear, smooth boundary.

B21t—12 to 18 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) when moist; weak, coarse, subangular blocky structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; few small pebbles and stones; neutral; abrupt, smooth boundary.

B22t—18 to 24 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; few small pebbles and stones; calcareous; mildly alkaline; a few small lime concretions; clear, smooth boundary.

B3—24 to 29 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure to moderate, medium, subangular blocky; hard when dry, firm when moist; few small pebbles and stones; calcareous; moderately alkaline; many small lime concretions; gradual, smooth boundary.

C—29 to 60 inches, equal parts light-gray (10YR 7/2) and very pale brown (10YR 7/4) clay loam, equal parts light brownish-gray (10YR 6/2) and light yellowish-brown (10YR 6/4) when moist; weak, medium, subangular blocky structure to massive; hard when dry, firm when moist; few small and medium pebbles and stones; calcareous; moderately alkaline; many pockets of soft white lime; common coarse, distinct, reddish-brown stains; a few iron concretions.

The A horizon ranges from 5 to 16 inches in thickness. It is clay loam or loam in texture and very dark gray to dark grayish brown in color.

The B horizon ranges from 12 to 25 inches in thickness. The lower part of the B horizon and the C horizon contain masses of white lime in old root channels, cracks, and openings. These layers are also streaked with few to many stains. Depth to lime is 15 to 30 inches. A few small stones, pebbles, and boulders are scattered throughout the profile.

Burchard soils are near the Pawnee, Shelby, and Steinauer soils, which also formed in limy till. Burchard soils have a less clayey B horizon than Shelby and Pawnee soils and are less deep to lime. They have a thinner solum and are shallower to lime than Shelby soils. Burchard soils are better developed than Steinauer soils.

Burchard clay loam, 7 to 12 percent slopes (BdC).—This soil has the profile described as representative for the series. It is well drained and occurs on convex side slopes and narrow ridgetops in the Oak Creek and Middle Creek drainage area. A few areas are cut by gullies.

Included with this soil in mapping are a few small areas of Morrill soils.

Nearly all areas of this soil are in native grass. Water erosion is a hazard unless a good cover is kept on this soil to control surface runoff. This soil is suitable for growing trees in windbreaks and for use as wildlife habitat. Capability unit IIIe–1, dryland, and IVe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Burchard clay loam, 7 to 12 percent slopes, eroded (BdC2).—This soil is on uplands. Its surface layer is thinner than that described as representative of the series. Also, it is slightly lighter in color, and lime is higher in the profile.

Included with this soil in mapping are a few small severely eroded areas.

Available water capacity is high in this soil, and moisture is released readily to plants. Water erosion is a hazard, and control of runoff is needed.

Most of the acreage is cultivated. This soil is suited to all crops commonly grown in the county and is also suitable for growing trees in windbreaks and for use as wildlife habitat. Capability unit IIIe–1, dryland, and IVe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Burchard-Steinauer clay loams, 12 to 17 percent slopes (BRD).—These soils are on uplands. About 60 percent of this complex is Burchard soils on concave slopes and along the upper parts of drainageways, and 40 percent is Steinauer soils on convex slopes where runoff is rapid.

The surface layer of the Burchard soil in this unit is thinner than that in the profile described as representative of the Burchard series. Also, the subsoil and underlying material contain more coarse gravel, small stones, boulders, and lime.

The Steinauer soil in this unit has a profile similar to that described as representative of the Steinauer series.

Most of the acreage of this unit is in permanent grass. The soils are suited to native grass, tame pasture, and close-growing cultivated crops. Trees grow well in windbreaks. In cultivated areas water erosion is a hazard. In overgrazed pastures gullies are likely to form in drainageways. Both soils in capability unit IVe–11, dryland; Burchard soils in Silty range site, and Steinauer soils in Limy Upland range site; both soils in Silty to Clayey windbreak suitability group.

Burchard-Steinauer clay loams, 12 to 17 percent slopes, eroded (BRD2).—About 70 percent of this complex is a Burchard clay loam that is strongly sloping and concave, and 30 percent is a Steinauer clay loam that is convex. About half of the original surface layer of these soils has been washed away by erosion.

Except that lime is nearer the surface in the more eroded areas, the Burchard soil in this complex has a profile similar to that described as representative for the Burchard series. Also, the clay loam subsoil and underlying material contain more pockets of lime, coarse gravel, stones, and small boulders. Except that the surface layer is thinner, the Steinauer soil in this complex has a profile similar to that described as representative for the Steinauer series.

A few areas of this complex are cultivated, and small grains and alfalfa are the main crops. Most of the acreage is in tame pasture consisting of mixed bromegrass and legumes. Some areas have been reseeded to native grasses. The strong slopes, medium fertility, severe hazard of erosion, and limitations to using large machinery make these soils better suited to pasture than to cultivated crops. Trees grow well in windbreaks. Upland wildlife use areas of these soils for cover and nesting and as a source of food. Both soils in capability unit IVe–11, dryland; Burchard soil is in Silty range site, and Steinauer soil is in the Limy Upland range site; both soils in Silty to Clayey windbreak suitability group.

Butler Series

The Butler series consists of deep, somewhat poorly drained, nearly level soils on uplands and stream terraces. These soils have a dense claypan subsoil. They formed in loess material.

In a representative profile the surface layer is dark-gray silt loam about 10 inches thick. The subsurface layer is 2 inches thick and is gray silt loam that changes abruptly to the claypan subsoil. The subsoil is 32 inches thick. The upper 14 inches of the subsoil is a very dark gray clay that is very hard when dry and very firm when moist. The next 9 inches is dark-gray silty clay. The lower 9 inches is gray silty clay loam. The underlying material is light brownish-gray silt loam that is moderately alkaline and contains a few faint reddish-brown stains.

Permeability of the Butler soils is slow. Available water capacity is high, but moisture is absorbed and released slowly to plants. These soils are slightly acid in the surface layer. Fertility is high.

These soils are cultivated. Crops that are grown on dryland areas show the effects of drought several days sooner than those grown on the more permeable soils which release moisture more readily. Because of the slowly permeable subsoil the surface layer is saturated with moisture during wet seasons. This causes some denitrification. Some of the Butler soils in the northwestern and central parts of the county are irrigated.

Representative profile of Butler silt loam (0 to 1 percent slopes) (in a cultivated field 50 feet west and 528 feet north of the southeast corner of sec. 3, T. 10 N., R. 1 E.):

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

A1—6 to 10 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; weak, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

A2—10 to 12 inches, gray (10YR 5/1) silt loam, dark gray (10YR 4/1) when moist; weak, medium and fine, crumb structure; slightly hard when dry, friable when moist; slightly acid; abrupt, smooth boundary.

B21t—12 to 26 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) when moist; moderate, coarse, prismatic structure that parts to strong, coarse, blocky; very hard when dry, very firm when moist; neutral; films on ped surfaces; clear, smooth boundary.

B22t—26 to 35 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) when moist; moderate, medium, prismatic structure that parts to strong, medium, blocky; very hard when dry, very firm when moist; neutral; films on ped surfaces; clear, smooth boundary.

B3—35 to 44 inches, gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; moderately alkaline; a few small, soft lime segregations; clear, smooth boundary.

C—44 to 60 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, friable when moist; moderately alkaline; a few fine, faint, reddish-brown stains.

The A horizon ranges from 7 to 14 inches in thickness and is medium acid to slightly acid. The A2 horizon ranges from 1 to 3 inches in thickness.

The B horizon ranges from 23 to 36 inches in thickness. The upper part of the B horizon ranges from black to very dark gray in color and is clay or silty clay in texture. The lower part ranges from silty clay to silty clay loam and is mildly alkaline and moderately alkaline.

The C horizon is light brownish-gray to gray silt loam to silty clay loam that contains a variable amount of reddish-brown mottles and few to many lime segregations. The water table is at a depth of 6 to 15 feet on stream terraces, but is more than 50 feet in the uplands.

Butler soils are near the Crete, Fillmore, Hastings, and Wymore soils. Butler soils have a thin gray A2 horizon and a darker, thicker, and finer textured B horizon than the Crete and Hastings soils. The Butler soils in Seward County generally have lime higher in the profile than these soils. They have a thinner, less distinct, gray A2 horizon than Fillmore soils and a darker more clayey B horizon than Wymore soils.

Butler silt loam (0 to 1 percent slopes) (Bu).—This soil has the profile described as representative of the series. It occurs on uplands. The areas range from 10 to 120 acres.

In some places the surface layer is gray or a faint gray and a subsurface layer is present.

Included with this soil in mapping are small areas of alkali slickspots. Also included are small areas of Fillmore soils, which were buried by several inches of fill material during land leveling.

The claypan subsoil is slowly permeable to water, air, and roots, and the surface layer is saturated during wet seasons. During dry seasons this soil releases moisture slowly to plants. Runoff is slow, and the content of organic matter is moderate.

Corn is grown in most areas that are irrigated, but in some areas soybeans and grain sorghum are grown. Areas that are dryfarmed are mainly in grain sorghum, wheat, and alfalfa. Trees grow well in windbreaks, and certain kinds of wildlife use these areas as sources of food. After about 2 years of growth, the root systems of most annual crops have difficulty extending through the dense claypan. The main concerns of management are maintaining fertility and managing water properly. Capability unit IIw–2, dryland, and IIw–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Butler silt loam, terrace (0 to 1 percent slopes) (2Bu).—This soil is on stream terraces of some major stream valleys. Areas of this soil range from 6 to 40 acres. The surface layer of this soil is less acid than that described as representative for the series. Also, the subsoil is not so thick and contains more segregated lime and some lime concretions. The depth to the water table ranges from 6 to 15 feet.

Included with this soil in mapping are small areas of Hobbs soils. Also included are a few small saline-alkali areas.

The slowly permeable subsoil limits the amount of rainfall or irrigation water that this soil can absorb and also the amount it releases to plants. Thus, more frequent irrigation is needed to maintain a good supply of moisture for plants. If managed for dryland the soil is droughty during dry seasons. Runoff is slow after rains.

Nearly all areas of this soil are cultivated, and grain sorghum, wheat, and alfalfa are the main crops. In areas where supplemental water is available, this soil is well suited to irrigation. Fertility needs to be maintained, and in irrigated areas managing water is a concern. Trees grow well in windbreaks. Capability unit IIw–2, dryland, and IIw–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Butler-Slickspots complex (0 to 1 percent slopes) (BT).—These soils have a claypan and occur on stream terraces of the major stream valleys. About 70 percent of this complex is Butler silt loam, terrace, and 30 percent is Slickspots. The areas of Slickspots are affected by saline-alkali characteristics. Moderate amounts of exchangeable sodium in the Slickspots cause the soil to be very sticky when wet and very hard when dry.

The surface layer of the Butler soil in this unit is slightly thinner than that described as representative of the Butler series. The Slickspots part of the complex has a profile similar to that described for Slickspots.

These soils are suitable for cultivation. Areas of Slickspots, however, are difficult to cultivate. Fewer crops grow on the Slickspots part of this complex than on the Butler part. Grain sorghum and legume crops are more tolerant of the alkali condition of these soils than corn, especially during dry seasons. In areas where the Slickspots are most common, this complex is best suited to grasses that tolerate alkali (*4*).

The main concerns of management are leaching sodium salts to a lower depth with irrigation water, improving tilth and permeability, and increasing the intake rate. Trees can be grown in windbreaks, and some kinds of upland wildlife use these areas for cover, nesting, and as a source of food. Both parts in capability unit IIIs–1, dryland, and IIIs–1, irrigated; Butler soils are in the Clayey range site and the Silty to Clayey windbreak suitability group; Slickspots is in the Saline Lowland range site and the Moderately Saline-alkali windbreak suitability group.

Crete Series

The Crete series consists of deep, moderately well drained soils on uplands and stream terraces. These soils formed in medium-textured loess.

In a representative profile the dark-gray silt loam surface layer is 14 inches thick. The subsoil is about 25 inches thick. The upper 10 inches is dark grayish-brown silty clay which is very hard when dry and very firm when moist. The middle 9 inches is brown silty clay. The lower 6 inches is grayish-brown silty clay loam. The underlying material is light brownish-gray silty clay loam to pale-brown silt loam, and it contains a few small lime concretions and has faint reddish-brown mottles.

Permeability of the Crete soils is slow. Available water capacity is high. Because the clayey subsoil absorbs and releases water slowly to plants, these soils are somewhat droughty during dry seasons. They are easy to till. Content of organic matter is moderate, and fertility is high.

Nearly all of the areas of Crete soils are cultivated, but a few areas remain in native grasses. These soils are well suited to most grain and legume crops that are commonly grown in the county under either dryland or irrigated management.

Representative profile of Crete silt loam, 0 to 1 percent slopes (in a cultivated field 75 feet south and 0.2 mile west of the northeast corner of sec. 30, T. 9 N., R. 3 E.):

Ap—0 to 7 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; medium acid; abrupt, smooth boundary.

A12—7 to 14 inches, dark-gray (10YR/1) silt loam, very dark gray (10YR 3/1) when moist; weak, medium subangular blocky structure that parts to weak, medium, crumb; slightly hard when dry, friable when moist; medium acid; clear, smooth boundary.

B21t—14 to 24 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, prismatic structure that parts to moderate, medium, blocky; very hard when dry, very firm when moist; slightly acid; clear, smooth boundary.

B22t—24 to 33 inches, brown (10YR 5/3) silty clay, dark brown (10YR 4/3) when moist; moderate, coarse, prismatic structure that parts to moderate, coarse, blocky; very hard when dry, very firm when moist; slightly acid; clear, smooth boundary.

B3—33 to 39 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure that parts to weak, coarse, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

C1—39 to 48 inches, light brownish-gray (10YR 6/2) silty clay loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist; mildly alkaline; a few small lime concretions; gradual, smooth boundary.

C2—48 to 60 inches, pale-brown (10YR 6/3) heavy silt loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist; calcareous; mildly alkaline; a few fine, faint reddish-brown mottles.

The A horizon ranges from 8 to 15 inches in thickness. It is silt loam in texture in most places, but on the very gently sloping soils along shallow upland drainageways it is silty clay loam in places. It ranges from dark brown to dark gray in color.

The B horizon ranges from 23 to 30 inches in thickness. It ranges from clay to silty clay in texture in the upper part, and it ranges from brown to dark grayish brown in color.

The C horizon ranges from silt loam to light silty clay loam and contains varying amounts of lime concretions and reddish-brown mottles. The reaction in the C horizon is neutral or mildly alkaline, and depth to lime ranges from 36 to 60 inches. The depth to the water table ranges from 8 feet in some areas on stream terraces to more than 100 feet in the uplands.

Crete soils are near the Butler, Fillmore, Hastings, and Wymore soils. Crete soils have a more clayey and darker B horizon than the Hastings soils. They are better drained and lack the A2 horizon that is in the Butler and Fillmore soils, and they have less distinct mottling in the lower part of the B and the C horizons than these soils. Crete soils have a dark colored B2 horizon than the Wymore soils, and they are less gray and contain fewer mottles in the lower part of the subsoil and substratum than the Wymore soils.

Crete silt loam, 0 to 1 percent slopes (Ce).—This soil has the profile described as representative for the series. It is on uplands. Included with this soil in mapping are a few small somewhat poorly drained depressions.

Runoff is slow on this soil. In areas that are dryfarmed, this soil is suited to grain sorghum, wheat, and alfalfa. In irrigated areas, corn and soybeans are the main crops. Trees grow well in windbreaks, and wildlife use the areas as a source of food.

Lime is needed for legumes. Fertility needs to be maintained. When not protected by vegetation, soil blowing is a hazard. Capability units IIs–2, dryland, and IIs–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Crete silt loam, 1 to 3 percent slopes (CeA).—This moderately well drained soil is on uplands and on the sides of shallow drainageways.

This soil has a thinner surface layer than that described as representative for the Crete series. The hazard of erosion is slight. Sheet erosion has removed some of the original surface soil on the longer slopes. Included with this soil in mapping are small areas of moderately eroded soils that have a silty clay loam surface layer.

Most areas of this soil are cultivated. This soil is well suited to grain sorghum, wheat, and alfalfa. Irrigated fields are mostly in corn, grain sorghum, and soybeans. Trees grow well in windbreaks. This soil is used by wildlife as a source of food and for habitat. Maintaining fertility is a main concern, and maintaining good tilth and conserving moisture are also concerns. During seasons of below normal rainfall, the soil is droughty unless irrigated. Capability units IIe–2, dryland, and IIe–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Crete silt loam, terrace, 1 to 3 percent slopes (2CeA).—This soil is on stream terraces of major valleys.

The surface layer and subsoil are not so thick as those in the profile described as representative for the Crete series. Also, the underlying material is more alkaline, contains more lime segregations, and is not so fine textured. Included with this soil in mapping are small areas of saline-alkali soils.

Nearly all areas of this soil are cultivated. Grain sorghum, wheat, and alfalfa are the main crops. Trees grow well in windbreaks. Wildlife use the areas as sources of food and as habitat. Because the subsoil is clayey and moisture is released slowly to plants, this soil is droughty for corn and soybeans during dry seasons. Fertility needs to be maintained. The main concerns of management are reducing runoff and conserving moisture. Capability units IIe–2, dryland, and IIe–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Fillmore Series

The Fillmore series consists of deep, poorly drained, nearly level soils that have a claypan. These soils formed in loess. They are in shallow depressions or basins on upland and are occasionally flooded by water from adjacent higher areas.

In a representative profile the surface layer is gray silt loam about 8 inches thick. The subsurface layer is light-gray silt loam about 4 inches thick. The subsoil is 29 inches thick. It is dark-gray silty clay in the upper 12 inches, gray silty clay in the next 8 inches, and gray silty clay loam in the lower 9 inches. The underlying material is grayish-brown silty clay loam that contains small amounts of lime and faint, yellowish-brown stains.

Available water capacity is high in these soils. Fertility is medium. Fillmore soils are occasionally ponded for 1 week to several weeks after intense rains. Unless adequate drainage outlets are provided, the excess water is removed slowly by evaporation and infiltration.

Most areas of Fillmore soils are cultivated, and a few are in permanent pasture.

Representative profile of Fillmore silt loam (in a cultivated field 150 feet north and 0.1 mile east of the southwest corner of sec. 27, T. 11 N., R. 1 E.):

Ap—0 to 8 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; medium acid; clear, smooth boundary.

A2—8 to 12 inches, light-gray (10YR 7/1) silt loam, gray (10YR 5/1) when moist; weak, medium, platy structure; soft when dry, very friable when moist; medium acid; abrupt, smooth boundary.

B21t—12 to 24 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) when moist; moderate, coarse, prismatic structure that parts to strong, medium, blocky; extremely hard when dry, extremely firm when moist; slightly acid; clear, smooth boundary.

B22t—24 to 32 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) when moist; moderate, coarse, prismatic structure that parts to moderate, medium, blocky; very hard when dry, very firm when moist; neutral; clear, smooth boundary.

B3—32 to 41 inches, gray (10YR 5.5/1) silty clay loam, dark gray (10YR 4/1) when moist; moderate, coarse and medium, subangular blocky structure; hard when dry, firm when moist; calcareous; mildly alkaline; gradual, smooth boundary.

C—41 to 60 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; mildly alkaline; streaks of soft lime; common medium, faint, yellowish-brown stains.

The A horizon ranges from 8 to 16 inches in thickness. The Ap horizon is very dark gray to gray in color, and it is medium acid to slightly acid in reaction. The grayish-colored A2 horizon ranges from 3 to 7 inches in thickness and from silt to silt loam in texture. The A horizon is thinnest in large depressions that are flooded for long periods. In areas where land leveling has been done, several inches of fill material generally have been added to the surface.

The B horizon ranges from 25 to 35 inches in thickness. It is black to dark-gray clay or silty clay that is slightly acid to neutral in the upper part of the horizon. The lower part of the B horizon is dark-gray to gray silty clay loam that ranges from mildly alkaline to moderately alkaline.

The C horizon ranges from grayish brown to light gray in color. It contains faint yellowish-brown to reddish-brown stains. Depth to lime ranges from 30 to 48 inches.

Fillmore soils are near the Butler, Crete, Hastings, and Scott soils. They have a thicker, more distinct A2 horizon than Butler soils and are not so well drained as those soils. Fillmore soils are not so well drained as Crete and Hastings soils, and they have an A2 horizon, which is lacking in those soils. They also have a darker more clayey subsoil. Fillmore soils have a thicker surface layer than Scott soils and occupy shallower depressions and basins that are flooded for shorter periods.

Fillmore silt loam (0 to 1 percent slopes) (Fm).—This is the only Fillmore soil mapped in the county. Slopes are less than 1 percent, and the areas receive runoff from adjacent higher areas.

The surface layer of this soil contains moderate amounts of organic matter. It is friable and is easy to till if rainfall is below normal. The subsoil is a dense claypan (fig. 9). It absorbs water slowly, releases the water to plants slowly, and is difficult for roots to penetrate.

Most of the acreage of this soil is cultivated. The main irrigated crops are corn, soybeans, and grain sorghum, and the main dryland crop is wheat. This soil is well suited to tame pasture, to trees grown in windbreaks, and to use as wildlife habitat.

Because this soil is occasionally ponded, spring planting is likely to be delayed and growing crops may be damaged. Drainage and a suitable gradient should be provided before this soil is irrigated. If legumes are grown, moderate amounts of lime are needed to reduce acidity of the surface layer. Capability unit IIIw-2, dryland, and IIs-21, irrigated; Clayey Overflow range site; Moderately Wet windbreak suitability group.

Geary Series

The Geary series consists of deep, gently sloping to strongly sloping, well-drained soils on uplands. These

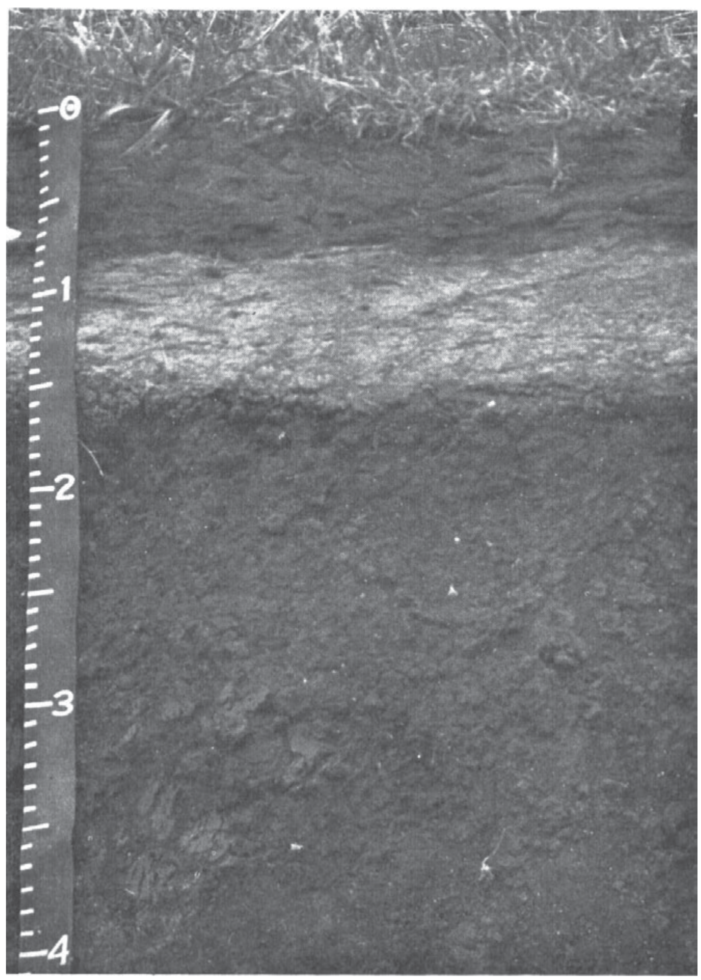

Figure 9.—**Profile of Fillmore silt loam showing the claypan in the subsoil.**

soils are on the lower parts of side slopes and on ridgetops. They formed in loamy reddish-brown loess (fig. 10) of the Loveland Formation and are moderately eroded to severely eroded.

In a representative profile the surface layer is dark grayish-brown light silty clay loam about 9 inches thick. The subsoil is silty clay loam and is 29 inches thick. It is mainly reddish brown in the upper 22 inches and light brown in the lower 7 inches. The subsoil is firm when moist and hard when dry. The underlying material is light-brown silty clay loam, is neutral, and contains no lime.

Permeability of these soils is moderately slow, but the soils are easily penetrated by plant roots. The available water capacity is high, and the soils release moisture readily to plants. Content of organic matter is moderate to moderately low, and fertility is medium to low.

Most areas of the Geary soils that have gentle to moderate slopes are cultivated and are well suited to most crops commonly grown in the county, but some of the severely eroded areas on these slopes are in tame pasture. Most of the strongly sloping soils are in native grasses or reseeded to cool-season grasses.

Representative profile of Geary silty clay loam, 7 to 12 percent slopes, eroded (in a cultivated field 100 feet east and 0.35 mile north of the southwest corner of sec. 10, T. 11 N., R. 3 E.):

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

B1—9 to 14 inches, reddish-brown (5YR 5/3) silty clay loam, dark reddish brown (5YR 3/3) when moist; weak, coarse and fine, subangular blocky structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B21t—14 to 24 inches, reddish-brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/3) when moist; weak, coarse, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B22t—24 to 31 inches, light reddish-brown (5YR 6/3) silty clay loam, reddish brown (5YR 4/4) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B3—31 to 38 inches, light-brown (7.5YR 6/4) silty clay loam, brown (7.5YR 4/4) when moist; weak, coarse, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; gradual, smooth boundary.

C—38 to 60 inches, light-brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist; neutral; a few small, dark reddish-brown concretions.

The A horizon ranges from 4 to 12 inches in thickness. It is silt loam to silty clay loam in texture and very dark brown to very dark grayish brown in color. The erosion ranges from moderate to severe. The reaction is slightly acid to neutral.

The B horizon ranges from 18 to 32 inches in thickness. It is silty clay loam to heavy silt loam in texture and light reddish brown to brown in color.

The C horizon is silty clay loam to silt loam in texture. It is reddish brown to light brown in color. In the western part of the county, this horizon contains no lime; but in the eastern part, lime is at a depth of 40 to 60 inches. A few small areas on the lower parts of side slopes that border the Big Blue River bottom lands contain coarse sand and gravelly material at a depth of 48 to 60 inches.

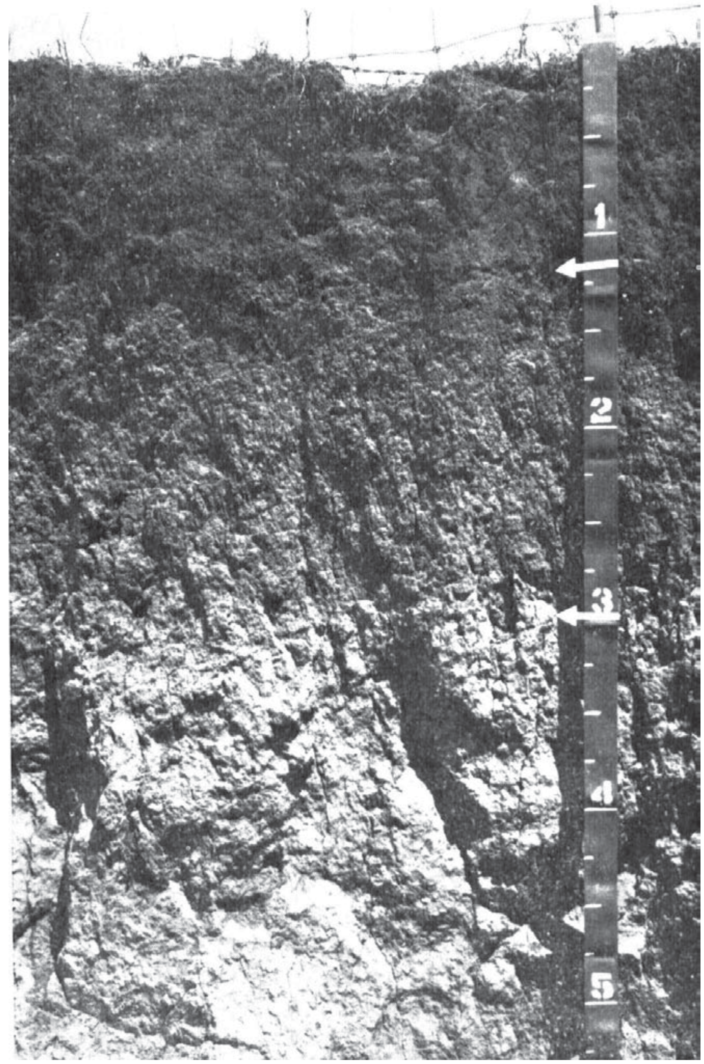

Figure 10.—**Profile of a Geary silty clay loam. This soil formed in reddish-brown loess of the Loveland Formation.**

Geary soils are near the Hastings, Longford, and Meadin soils. They formed in reddish-brown loess similar to the loess in which Longford soils formed, but are not so clayey in their subsoil. Geary soils are more reddish brown in the B and C horizons than the Hastings soils. They are on adjacent slightly higher side slopes and have a finer textured profile than Meadin soils, which have a mixed sand and gravel substratum.

Geary silt clay loam, 3 to 7 percent slopes, eroded (GeB2).—This soil is on ridgetops and the upper sides of drainageways.

The soil has a slightly thicker surface layer and subsoil than that in the profile described as representative for the Geary series. Also, it is slightly more acid. Included with this soil in mapping are a few areas where the underlying material has limy till at a depth of 40 to 60 inches.

Runoff is medium on this soil. Permeability is moderately slow, but available water capacity is high. The content of organic matter is moderately low and fertility is medium.

Nearly all of the areas of this soil are cultivated, and grain sorghum, wheat, and alfalfa are the main crops. Trees can be grown in windbreaks. Wildlife use the areas for habitat. Controlling water erosion and runoff are the main concerns of management on this soil. Capability units IIIe-11, dryland, and IIIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Geary silty clay loam, 7 to 12 percent slopes, eroded (GeC2).—This soil has the profile described as representative for the Geary series. It is a well-drained soil on uplands that are on the lower part of sides to drainageways.

Included with this soil in mapping are small areas of Meadin soils.

Permeability is moderately slow, and runoff is medium. Available water capacity is high, content of organic matter is moderately low, and fertility is medium.

Most areas of this soil are cultivated, and the main crops are wheat, alfalfa, and grain sorghum. A small acreage is seeded to tame grasses. This soil is also suited to trees, to use as wildlife habitat, and to recreation. The main concerns of management on these soils are water erosion, soil blowing, and the control of runoff. Capability units IVe-1, dryland, and IVe-12, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Geary silty clay loam, 7 to 12 percent slopes, severely eroded (GeC3).—This well-drained soil is mostly on the lower part of slopes of upland drainageways. Much of the original surface layer and, in places, some of the subsoil have been removed by erosion.

The surface layer is thinner and lighter colored than that described as representative of the Geary series. In most places, the surface layer and subsoil have been mixed by cultivation.

Included with this soil in mapping are a few small areas that contain coarse sandy and gravelly material in the underlying material.

Because of the severe erosion, many rills and small gullies formed in this soil. Permeability is moderately slow, and runoff is medium to rapid. Content of organic matter is low, causing poor tilth of the surface layer. Fertility is low.

Nearly all areas of this soil are cultivated or seeded to tame grasses. The main crops are grain sorghum and wheat. Alfalfa is commonly grown with bromegrass in pastures. This soil is suited to trees grown in windbreaks, to use as wildlife habitat, and as a source of food for wildlife. Improving soil tilth and fertility are needed on this soil. Water erosion is a hazard. Capability unit IVe-8, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Geary silty clay loam, 12 to 31 percent slopes, severely eroded (GeE3).—This soil is on sides of upland drainageways. Areas that were cultivated have lost much of their original surface layer and subsoil through erosion.

The present surface layer is lighter in color, thinner, and lower in content of organic matter than that in the profile described as representative for the series. The subsoil is also thinner.

Included with this soil in mapping are areas of coarse sandy and gravelly material and areas where the underlying material contains small lime concretions.

Permeability is moderately slow in this soil and runoff is rapid. Fertility is low. Because of the steep slopes, the severe hazard of erosion, and the limitation on use of large machinery, this soil is best suited to perennial grasses and legumes. Trees can be grown in windbreaks.

Most of the acreage of this soil is in native grasses or tame pasture. Lime is needed for legumes. Water erosion is a hazard in areas where grasses are not well established. Gullying needs to be controlled. Capability unit VIe-8, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Hall Series

In the Hall series are deep, well-drained, nearly level to very gently sloping soils on stream terraces. These soils formed in silty material, and they are slightly eroded to moderately eroded.

In a representative profile the surface layer is dark-gray to very dark grayish-brown silt loam about 14 inches thick. The subsoil is about 25 inches thick and is firm when moist and hard when dry. The upper 12 inches is dark grayish-brown silty clay loam. The middle 6 inches is grayish-brown silty clay loam. The lower 7 inches is grayish-brown silty clay loam. The underlying material is mildly alkaline, light-gray silt loam that has many faint reddish-brown stains and a few small iron concretions.

Permeability of these soils is moderately slow. Available water capacity is high. Content of organic matter is moderate, and fertility is high. These soils are easy to work, and plant roots penetrate them easily. They receive only a small amount of additional water from the bordering uplands or the small intermittent drainageways which extend throughout the stream terraces.

Most areas of the Hall soils are cultivated. They are suitable for most grain and legume crops that are commonly grown in the county. Some of the nearly level soils are irrigated where ground water is available.

Representative profile of Hall silt loam, 1 to 3 percent slopes (in a cultivated field 200 feet south and 0.45 mile east of northwest corner of sec. 26, T. 12 N., R. 2 E.):

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

A12—7 to 14 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B1—14 to 19 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse and medium, subangular blocky structure; hard when dry, firm when moist; neutral; clear, smooth boundary.

B21t—19 to 26 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B22t—26 to 32 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure that parts to moderate, coarse, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B3—32 to 39 inches, gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) when moist; weak, coarse, subangular blocky structure that parts to moderate, medium, subangular blocky; hard when dry; firm when moist; mildly alkaline; common medium, distinct, reddish-brown mottles and a few small iron concretions; gradual, smooth boundary.

C—39 to 60 inches, light-gray (5Y 6/1) silt loam, gray (5Y 5/1) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; mildly alkaline; many medium, faint, reddish-brown stains; a few small iron concretions.

The A horizon ranges from 6 to 18 inches in thickness. It ranges from silt loam to silty clay loam in texture and from very dark gray to dark grayish brown in color.

The B horizon ranges from 20 to 28 inches in thickness. It is heavy silt loam to silty clay loam.

The C horizon is gray to pale-brown light silty clay loam to silt loam, and commonly has reddish-brown or yellowish-brown stains and a few small iron concretions. Small amounts of lime are in the C horizon on areas of Slickspots. The depth to the water table ranges from 8 to 20 feet.

Hall soils are near the Butler, Crete, and Hord soils on the nearly level stream terraces. Hall soils have a less clayey B horizon than Butler and Crete soils, but their B horizon is not so fine textured. Hall soils on stream terraces have a finer textured, thinner A horizon and a more highly developed profile than Hobbs soils on bordering foot slopes.

Hall silt loam, 0 to 1 percent slopes (Ha).—This soil is on stream terraces. It has a slightly thicker surface layer and subsoil than that in the profile described as representative for the series. Also, it is slightly higher in content of organic matter and in fertility. Included with this soil in mapping are small areas of Crete soils that have a finer textured subsoil.

Permeability of this soil is moderately slow, but the available water capacity is high and moisture is released readily to plants. Runoff is medium, and the soil is easy to till. It is suited to most crops. Corn is the main irrigated crop. Grain sorghum, wheat, and soybeans are commonly grown in dryland areas. Lime and phosphate are needed for alfalfa. Capability units I–1, dryland, and I–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hall silt loam, 1 to 3 percent slopes (HaA).—This soil has the profile described as representative for the series. It is on stream terraces that mostly border shallow intermittent drainageways. Included with this soil in mapping are a few small saline-alkali areas.

Runoff is medium on this soil and permeability is moderately slow. Available water capacity is high, and this soil releases moisture readily to plants. It is easy to till, and plant roots penetrate the subsoil easily.

Most areas of this soil are cultivated, and a few areas are irrigated. Grain sorghum, corn, and wheat are the main crops and are commonly in a cropping system with soybeans and alfalfa. Lime is needed for legumes. Reducing surface runoff and conserving the moisture are concerns if the soil is farmed. Soil blowing is also a concern, especially when the soil is not protected by vegetation. This soil is suited to growing trees in windbreaks and for use by wildlife. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hall-Slickspots complex, 1 to 3 percent slopes (HSz).—This complex is on stream terraces on side slopes that border bottom lands and along intermittent shallow drainageways. It is very gently sloping. About 65 percent of the complex is Hall soils, and about 35 percent is moderately saline-alkali areas known as "Slickspots."

In the Hall soil (fig. 11) the surface layer is thinner, lighter in color, and finer textured than that described as representative for the series. Also, the surface layer and subsoil are more alkaline in the Hall soil, and the surface layer is lower in fertility and content of organic matter. In the Slickspot areas the surface layer is thin and is commonly light gray in color because of the soluble salts. Structure is weak in these areas, and lime concretions and salt crystals are in the profile.

The Slickspot areas absorb water slowly. Water commonly remains in small pockets on the surface for several days after rain. This may cause tillage limitations as the surface layer is very sticky when wet and when dry is very hard. The available water capacity of the Hall soil is high, and moisture is readily released to plants. Slickspot areas, however, hold less water and release moisture more slowly. Because of the higher alkalinity in Slickspots, nutrient deficiencies are more common.

Certain tree species are suitable for windbreaks. Wildlife use areas of this soil for habitat, nesting, and as sources of food.

The saline-alkali condition of these areas is the main concern of management. It causes poor tilth, slow permeability, and a lack of availability of plant nutrients. Capability units IIIs–1, dryland, and IIIs–1, irrigated; Hall soils are in the Silty Lowland range site and Silty to Clayey windbreak suitability group; Slickspots are in the Saline Lowland range site and Moderately Saline-alkali windbreak suitability group.

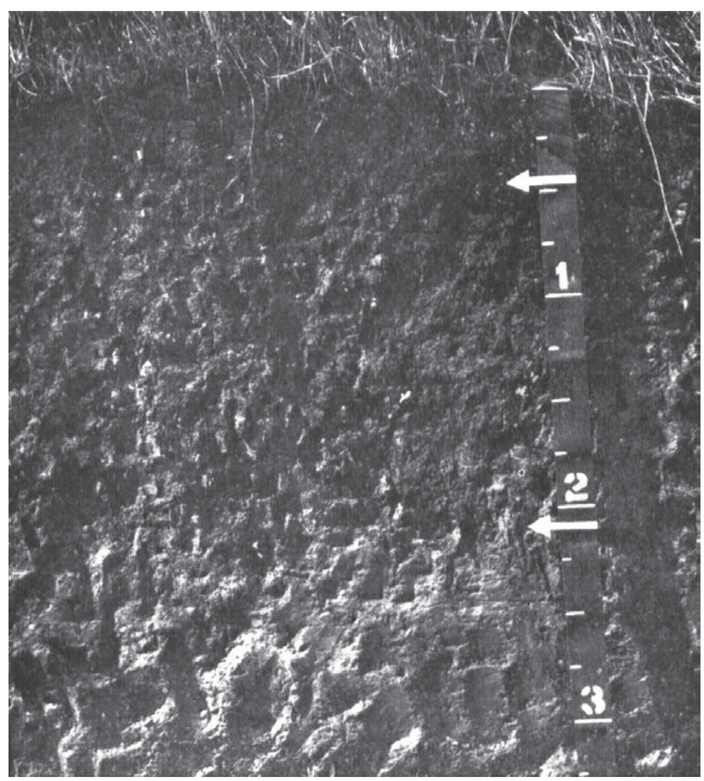

***Figure 11.*—Profile of the Hall part of Hall-Slickspots complex, 1 to 3 percent slopes.**

Hastings Series

The Hastings series consists of deep, nearly level to strongly sloping soils on uplands and stream terraces. These soils are well drained and formed in silty loess.

In a representative profile the upper 6 inches of the surface layer is dark-gray silt loam. The lower 7 inches is dark-gray silty clay loam. The subsoil is about 29 inches thick. The upper 5 inches is dark grayish-brown silty clay loam. The middle 18 inches is brown silty clay loam, and the lower 6 inches is pale-brown silty clay loam. The subsoil is firm when moist and hard when dry. The underlying loess material is very pale brown silt loam.

Permeability of these soils is moderately slow. The soils are easy to till. Available water capacity is high, and the soil releases moisture readily to plants.

The Hastings soils are well suited to cultivated crops. They are mostly in row crops and smaller acreages of legumes. Nearly level soils in the western part of the county are irrigated in many areas where water is available. Some areas on very gentle slopes are being developed for irrigation. A few areas of severely eroded moderate slopes have been seeded to tame pasture.

Representative profile of Hastings silt loam, 0 to 1 percent slopes (in a cultivated field 50 feet west and 0.15 mile south of the northeast corner of sec. 21, T. 12 N., R. 1 E.):

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

A12—6 to 13 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, medium, granular; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B1—13 to 18 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse and fine, subangular blocky structure; hard when dry, firm when moist; slightly acid; clear, smooth boundary.

B21t—18 to 25 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B22t—25 to 36 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; moderate, coarse, prismatic structure that parts to moderate, medium, subangular blocky; moisture films on ped faces; hard when dry, firm when moist; neutral; clear, smooth boundary.

B3—36 to 42 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure that parts to weak, medium, subangular blocky; hard when dry, firm when moist; neutral; a few small manganese concretions; clear, smooth boundary.

C—42 to 60 inches, very pale brown (10YR 7/3) silt loam; light olive brown (2.5Y 5/4) when moist; massive; slightly hard when dry, friable when moist; neutral.

The A horizon ranges from 6 to 18 inches in thickness. It ranges from silt loam in nearly level soils to silty clay loam on the moderately sloping soils and from dark gray to very dark brown. The reaction ranges from medium acid to neutral.

The B2 horizon ranges from silty clay loam to light silty clay in texture and from dark brown to brown in color.

The C horizon is silt loam to light silty clay loam in texture and very pale brown to yellowish brown in color. Small lime concretions are at or near the surface in some severely eroded soils on strong slopes. The thickness of the Peoria loess ranges from 15 to more than 90 feet.

Hastings soils are near the Butler, Crete, Fillmore, and Scott soils. They have a less clayey B horizon than the Butler and Crete soils, and lime is at a greater depth. Hastings soils have a loamy B horizon and are well drained and lack the dense claypan B horizon of the Fillmore and Scott soils.

Hastings silt loam, 0 to 1 percent slopes (Hs).—This soil has the profile described as representative for the Hastings series (fig. 12). It is a well-drained soil on uplands and has more acreage that is irrigated than any other soil in the county.

Included with this soil in mapping are a few small depressions of the somewhat poorly drained Fillmore soils.

Runoff is slow on this soil. Fertility is high, and the content of organic matter is moderate. The soil absorbs and releases moisture readily to plants.

This soil is well suited to most crops, and corn is the main irrigated crop. Grain sorghum and wheat are grown

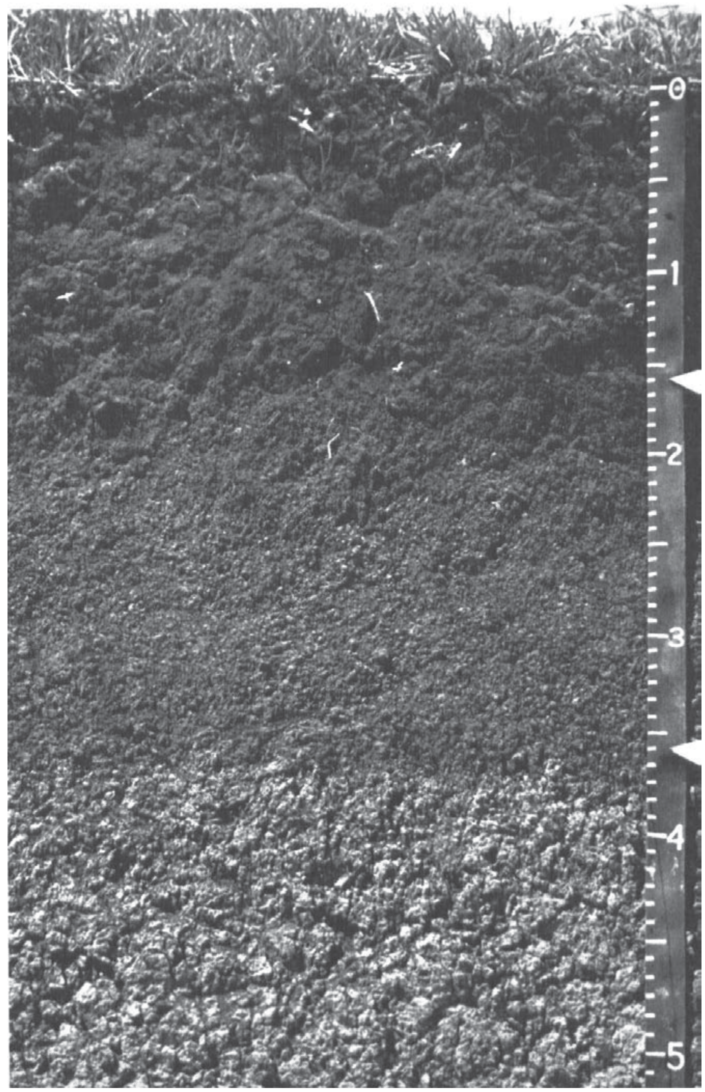

Figure 12.—Profile of a Hastings silt loam, one of the best irrigated soils in Seward County.

mostly on the dryland areas of this soil. In the few small areas where the surface layer has been removed during land leveling, this soil lacks trace elements and is low in content of organic matter. It is suitable for growing trees in windbreaks and for use by wildlife. Lime is needed for establishing legumes. The main concerns of management under irrigation are maintaining fertility and managing water. Capability units I–1, dryland, and I–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings silt loam, 1 to 3 percent slopes (HsA).—This is a well-drained soil on uplands. Except for a slightly thinner surface layer and subsoil, it has a profile similar to the one described as representative for the Hastings series.

This soil is well suited to all crops commonly grown in the county. In areas of irrigated soil, corn and grain sorghum are the main crops. Under dryland management wheat, soybeans, and alfalfa are commonly grown. Trees grow well in windbreaks, and wildlife use these areas for habitat and as sources of food. Because the surface layer is medium acid to slightly acid, moderate amounts of lime are needed for legume crops. Water erosion, soil blowing, and maintaining fertility are the main concerns of management. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings silty clay loam, 1 to 3 percent slopes, eroded (HtA2).—This well-drained soil is on uplands. Most of the slopes are 2 or 3 percent.

This soil has a profile similar to the one described as representative for the Hastings series, except that the surface layer is thinner, slightly finer in texture, and not so acid. Included with this soil in mapping are small areas of Crete soils along the upper parts of some minor upland drainageways.

Runoff is medium on this soil. The content of organic matter is moderately low, and fertility is medium. Erosion is a hazard on long slopes in cultivated areas.

This soil is well suited to cultivation. Wheat, grain sorghum, and alfalfa are the main dryland crops, and corn and grain sorghum are the main irrigated crops. The soil is suited to trees and is used as wildlife habitat. Water erosion and soil blowing are the main concerns of management. Fertility needs to be improved and maintained. Capability units IIe–1, dryland, and IIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings silty clay loam, 3 to 7 percent slopes, eroded (HtB2).—This well-drained soil is on uplands. It borders some of the shallower, entrenched, intermittent drainageways.

This soil has a thinner, finer textured surface layer and a thinner subsoil than that in the profile described as representative for the series. Included with it in mapping are small areas of severely eroded soils that have a heavy silty clay loam surface layer. Consistence of the soils in these areas is sticky when wet and hard when dry. Fertility of the soils is low in these areas.

Runoff is medium on this soil. Fertility is medium and the content of organic matter is moderately low.

This soil is suited to most crops commonly grown in the county. Grain sorghum, wheat, corn, and alfalfa are the main crops. Trees grow well in windbreaks. Controlling water erosion and surface water are the main concerns of management. Fertility needs to be improved and maintained. Capability units IIIe–11, dryland, and IIIe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings silty clay loam, 7 to 12 percent slopes, eroded (HtC2).—This is a well-drained soil on uplands on the sides of intermittent drainageways. Its upper slopes border the bottom lands of the Big Blue River and its tributaries.

The surface layer of this soil is thinner and finer textured than that described in the representative profile for the Hastings series. Also, it is not so acid and has a thinner subsoil. Small lime concretions are common in places in the lower part of the subsoil and in the underlying material. Included with this soil in mapping are small areas of Slickspots (fig. 13) that are 1 to 3 acres in size.

Runoff is medium, and in some places small rills form during rainstorms. Fertility is medium, and the content of organic matter is moderately low.

Most of this soil is cultivated, and wheat, grain sorghum, and alfalfa are the main crops. Small areas are seeded to tame grasses and used for pasture. Trees grow well in windbreaks, and wildlife use windbreaks as habitat or as a source of food.

Controlling erosion is the main concern of management on this soil. Fertility needs to be maintained. Capability units IVe–1, dryland, and IVe–12, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings silty clay loam, 3 to 7 percent slopes, severely eroded (HtB3).—This well-drained soil is on ridgetops and on short side slopes along drainageways in the uplands and on stream terraces. Erosion has removed most of the surface layer and, in places, part of the subsoil.

Figure 13.—Slickspots are an inclusion in some areas of Hastings soils. They affect tillage because of the poor tilth.

The present surface layer is lighter in color and finer in texture than that described as representative for the Hastings series. This is because cultivation has mixed the surface layer and subsoil. Also, the surface layer and subsoil are thinner than that of the representative profile. Small lime concretions are common above a depth of 48 inches.

Runoff is medium to rapid on this soil. Fertility and the content of organic matter are low. Rills commonly develop during rainstorms.

Most areas of this soil are cultivated, and the main crops are grain sorghum, corn, and wheat. Trees grow in windbreaks, and wildlife use the windbreaks for nesting, cover, sources of food, and general habitat. Controlling erosion and improving fertility are the main concerns of management. Content of organic matter needs to be increased. Capability units IIIe-81, dryland, and IIIe-11, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings silty clay loam, 7 to 12 percent slopes, severely eroded (HtC3).—This well-drained soil is on uplands. Most of the surface layer has been removed by erosion. In some areas cultivation has mixed the remaining surface layer with the lighter colored subsoil.

The surface layer of this soil is thinner, finer in texture, and lighter in color than that of the soil described as representative for the series. Also, the subsoil is thinner (fig. 14), and the lower part of the subsoil and the underlying material contain small concretions of lime.

Runoff is medium to rapid on this soil. Fertility and content of organic matter are low. Many rills and a few small gullies are in these areas.

Most of the areas of this soil are cultivated. Sorghum, wheat, and alfalfa are the main crops. Some areas have been seeded to bromegrass and are used for pasture. This soil is used for growing trees in windbreaks and is used by wildlife for habitat. Controlling water erosion and gullies and improving fertility are the main concerns of management. Capability units IVe-81, dryland, and IVe-13, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings silty clay loam, 12 to 17 percent slopes, severely eroded (HtD3).—This soil is on uplands. In areas where the soil has previously been cultivated, erosion has removed most of the surface soil and commonly part of the subsoil.

The surface layer is finer textured, lighter colored, and thinner than that in the profile described as representative for the series. Also, the subsoil is thinner, and lime concretions are common within a depth of 24 inches of the surface. Included with this soil in mapping are small areas of reddish-brown loess and some steep breaks along tributaries of the Big Blue River.

Runoff is rapid on this soil. Fertility and the content of organic matter are low. Many rills and small gullies are common in areas of overgrazed pastures.

Most areas of this unit are in tame pasture or perennial grass. Bromegrass and alfalfa are commonly used for pastures. This soil is suitable for growing trees in windbreaks and for use by wildlife. Water erosion and gullying are hazards even though most areas are in grass. Capability unit VIe-8, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Figure 14.—**Profile of Hastings silty clay loam, 7 to 12 percent slopes, severely eroded. The soil is low in fertility and content of organic matter. This area was seeded to an introduced grass.**

Hastings silty clay loam, terrace, 3 to 7 percent slopes, eroded (2HtB2).—This soil is on stream terraces along the Big Blue River and its tributaries. It has a thinner surface layer and subsoil than that in the profile described as representative for the series. Also, the surface layer is finer in texture and less acid. Included with this soil in mapping are small areas of Slickspots.

Runoff is medium on this soil. Fertility is medium, and content of organic matter is moderate.

Most of this soil is cultivated, and about 20 percent is in areas where water is available and is irrigated. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa when dryfarmed and well suited to corn and grain sorghum when irrigated. Runoff and water erosion are the main concerns. Fertility needs to be improved and maintained. Trees grow well in windbreaks. Capability units IIIe-11, dryland, and IIIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Hastings soils, 1 to 3 percent slopes, severely eroded (HnA3).—These soils are on uplands and stream terraces.

Most of the surface layer and subsoil have been removed and used for subbase fill in highway construction. Texture of the surface layer is silt loam and silty clay loam.

These soils are less acid and have a lighter colored and thinner surface layer than the soil described as representative for the series. In places the present surface layer is a mixture of the former subsoil and material from the upper part of its underlying layer. Included with these soils in mapping are small areas of reddish-brown loess and Slickspots.

Runoff is medium on these soils. Consistence is sticky when the soils are wet and hard when they are dry. Fertility and the content of organic matter are low.

The content of organic matter needs to be increased and maintained in these soils, and fertility needs to be improved and kept at the improved level. Water erosion and soil blowing are hazards in areas that are not protected by plant cover. Certain areas are suited to bromegrass pasture and alfalfa, and the soils are suited to grass and trees. Wildlife use areas that have a vegetative cover for habitat or as a source of food. Capability units IIIe-8, dryland, and IIe-11, irrigated; Silty range site, Silty to Clayey windbreak suitability group.

Hobbs Series

The Hobbs series consists of deep, well drained and moderately well drained, nearly level to gently sloping soils. These soils formed in recently deposited silty sediment. These soils are on seldom flooded bottom lands and foot slopes, in valleys of perennial streams, and on narrow, occasionally flooded bottom lands along intermittent drainageways.

In a representative profile the texture is silt loam throughout. The surface layer is 33 inches thick. It is grayish brown to gray in the upper 14 inches and gray to dark gray in the rest of the layer. The transitional layer is dark gray and is 15 inches thick, and the material below is gray to a depth of 60 inches.

Permeability of the Hobbs soils is moderate, but the soils are easily penetrated by plant roots. The available water capacity is high, and the soils release moisture readily to plants. They are easy to till. These soils receive additional moisture during floods mostly in spring and early in summer.

These soils are suitable for cultivated crops. Some of the nearly level areas that border major stream channels are irrigated with water pumped out of the stream. Some areas that are occasionally flooded are in native grasses.

Representative profile of Hobbs silt loam, occasionally flooded (in a pasture 100 feet east and 0.35 mile south of the northwest corner of sec. 18, T. 10 N., R. 3 E.):

A11—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark gray (10YR 3/1) when moist; weak, medium, crumb structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

A12—7 to 14 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; weak, medium, platy structure that parts to weak, coarse, crumb; slightly hard when dry, friable when moist; slightly acid; common medium, faint, yellowish-brown mottles; abrupt, smooth boundary.

A13—14 to 17 inches, gray (10YR 6/1) silt loam, dark gray (10YR 4/1) when moist; weak, coarse, platy structure that parts to weak, fine, subangular blocky; slightly hard when dry, friable when moist; neutral; common medium, faint, yellowish-brown mottles; abrupt, smooth boundary.

A14—17 to 33 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; weak, coarse to medium, subangular blocky structure; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

AC—33 to 48 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, coarse, subangular blocky structure to massive; slightly hard when dry, friable when moist; neutral; gradual, smooth boundary.

C—48 to 60 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) when moist; massive; slightly hard when dry, friable when moist; neutral.

The A horizon ranges from 12 to 40 inches in thickness. It ranges from very fine sandy loam in nearly level areas that border the major stream channels to silty clay loam in areas next to stream terraces. The A horizon is black to dark brown, and reaction ranges from slightly acid to medium acid. The lower part of the A horizon and places in the C horizon contain stratified layers that range from very dark gray to grayish brown in color and fine sandy loam to silty clay loam in texture. These layers consist of eroded material deposited on the flood plain from the uplands. The material is mostly noncalcareous, neutral, and friable. The depth to the water table ranges from 6 to more than 15 feet. The Hobbs soils that are seldom flooded and those on foot slopes contain a silt loam to silty clay loam C horizon.

Hobbs soils are near the Hord and Lamo soils. They have a less clayey profile than the Lamo soils; their water table is at a lower depth; and they are noncalcareous to a depth of 60 inches. Hobbs soils are on the lower part of occasionally flooded bottom lands, and Hord soils are on stream terraces. Hobbs soils are more stratified and less developed than Hord soils.

Hobbs silt loam, occasionally flooded (0 to 1 percent slopes) (2Hb).—This soil has the profile described as representative for the series (fig. 15). This moderately well drained soil is on bottom lands. It has many intermittent drainageways that are occasionally flooded for short periods after heavy rains.

Included with this soil in mapping are areas of short, moderate slopes that separate bottom lands from stream terraces.

Because sediment is deposited during major floods, irrigated fields sometimes are damaged and need leveling to reestablish grades. Flood damage also can make the reseeding of newly planted crops necessary or can delay tillage operations. Fertility is high on this soil.

Crops grow well on this soil during seasons of little or no flooding. The main crops are corn in irrigated areas and grain sorghum and alfalfa in dryland areas. Areas not readily drained or that contain springs and seep areas are in native grasses and tame pastures. Maintaining fertility is a concern, especially when the soil is irrigated. Flooding is the main hazard on this soil. Trees are well suited in windbreaks. Capability unit IIw-3, dryland, and IIw-3, irrigated; Silty Overflow range site; Moderately Wet windbreak suitability group.

Hobbs silt loam, 0 to 1 percent slopes (Hb).—This well-drained soil is on bottom lands. It is seldom flooded, and flooding occurs only during seasons of abnormally high rainfall. The surface layer of this soil is darker in color and the profile is less stratified than that described as representative for the series.

Included with this soil in mapping are narrow areas on higher bottom lands that border the main channel of the Big Blue River. In these areas the surface layer and subsoil are fine sandy loam.

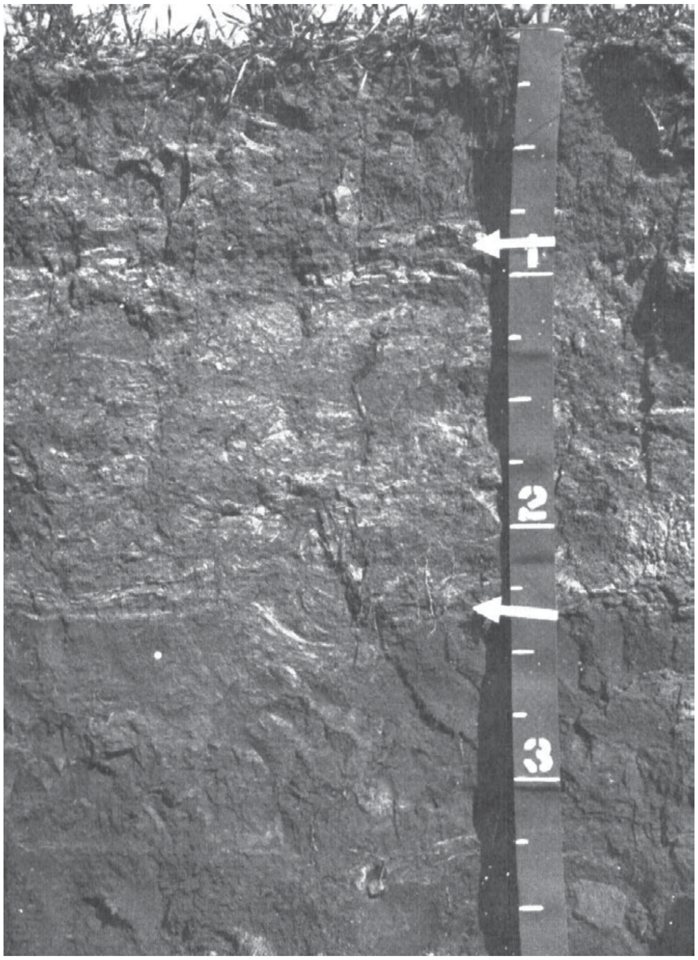

Figure 15.—**Profile of Hobbs silt loam, occasionally flooded. This soil on bottom lands contains a thick surface layer.**

Fertility is high, and this soil seldom has a total crop loss from flooding. This soil releases moisture readily to plants and is easy to till.

Where irrigation water is available corn is the main crop. Areas that are dryfarmed are mainly in grain sorghum, wheat, soybeans, and alfalfa. Maintaining fertility is the main concern of management. Capability unit I–1, dryland, and I–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hobbs silt loam, 1 to 3 percent slopes (HbA).—This soil is on foot slopes that border uplands. It is well drained but receives some moisture and deposits of medium-textured sediment that is eroded from the adjacent uplands.

The surface layer and transitional layer are slightly finer textured than those described as representative for the series. The surface layer consists mostly of sediment which washed downslope from adjacent uplands. This layer contains characteristics that vary according to the nature of these higher slopes.

This soil is suitable for most crops grown in the county. Corn, grain sorghum, and wheat are the main crops. Small acreages are irrigated where water is available. Erosion and soil blowing are the main hazards. Fertility needs to be maintained at a high level. Capability unit IIe–1, dryland, and IIe–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hobbs silt loam, 3 to 7 percent slopes (HbB).—This soil is on foot slopes and along minor drainageways on uplands. It is well drained and is seldom flooded but receives some moisture from adjacent higher uplands.

This soil has a profile that has a lighter colored surface layer and finer textured subsoil than that described as representative for the series. Also, the profile is not so stratified and is less acid. Included with this soil in mapping are areas that have a surface layer of silty clay loam that is moderately alkaline.

Permeability of this soil is moderate. Available water capacity is high, and the soil is easily penetrated by plant roots. The main concerns of management are water erosion, soil blowing, and maintaining fertility.

Most of the acreage of this soil is cultivated. Grain sorghum, corn, wheat, and soybeans are the main crops. Alfalfa is commonly included in the crop sequence. Capability unit IIIe–11, dryland, and IIIe–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hobbs silty clay loam, 0 to 1 percent slopes (Hc).—This moderately well drained soil is on bottom lands of major streams. It is seldom flooded.

This soil has a finer textured surface layer and underlying material than that described as representative for the series. It is also darker colored and not so acid. Depth to the water table ranges from 6 to 10 feet.

This soil is seldom flooded, but flooding occurs after heavy rain in the upper drainage areas. The rains are of short duration. Because of the high available water capacity of this soil the additional moisture stored early in spring benefits crops during summer months that are hot and dry. Permeability is moderately slow. Fertility is high.

Corn, grain sorghum, and soybeans are the main crops. Some areas are irrigated with water from the Big Blue River and Lincoln Creek. Maintaining fertility is the main concern of management. Capability unit I–1, dryland, and I–1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Hord Series

The Hord series consists of deep, well-drained, nearly level soils. These soils formed in medium-textured loess on stream terraces.

In a representative profile the surface layer is mainly dark-gray silt loam about 17 inches thick. The subsoil is 20 inches thick. The upper 6 inches of the subsoil is dark grayish-brown silt loam which is friable when moist and slightly hard when dry. The next 6 inches is grayish-brown silt loam, and the lower 8 inches is brown heavy silt loam. The underlying material is pale-brown heavy silt loam that is neutral in reaction, friable when moist, and slightly hard when dry.

Permeability of Hord soils is moderate. Available water capacity is high, and moisture is released readily to plants. These soils receive some additional water as runoff from the bordering uplands. This moisture commonly is more beneficial than damaging to growing crops.

Content of organic matter is moderate, and fertility is high.

These soils are suitable for cultivated crops. Areas where water is available are irrigated. These soils are easy to till and readily penetrated by plant roots.

Representative profile of Hord silt loam, 0 to 1 percent slopes (in a cultivated field 75 feet south and 0.4 mile east of the northwest corner of sec. 32, T. 10 N., R. 1 E.):

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

A12—6 to 12 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) when moist; weak, medium, subangular blocky structure that parts to weak, medium, granular; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

A13—12 to 17 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) when moist; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B1—17 to 23 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse and medium, subangular blocky structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B2—23 to 29 inches, grayish-brown (10YR 5/2) heavy silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure that parts to weak, coarse, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

B3—29 to 37 inches, brown (10YR 5/3) heavy silt loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure that parts to weak, medium, subangular blocky; slightly hard when dry, friable when moist; neutral; clear, smooth boundary.

C—37 to 60 inches, pale-brown (10YR 6/3) heavy silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; neutral.

The A horizon ranges from 12 to 20 inches in thickness and is dark gray to very dark brown in color and medium acid to slightly acid in reaction.

The B horizon ranges from 16 to 30 inches in thickness. It ranges from silt loam to light silty clay loam and from dark grayish brown to dark brown.

The C horizon is silt loam to light silty clay loam and brown to pale brown. It ranges from neutral to mildly alkaline in reaction. It generally is medium in texture and is similar to the loess in the bordering uplands, but resembles alluvial-colluvial sediment along drainageways.

Hord soils are near the Butler, Crete, and Hall soils. The Hord soils have less clay in the B horizon than these soils. They are on stream terraces, whereas Hobbs soils are on bordering foot slopes. Hobbs soils have a profile that contains stratified layers of medium-textured sediment.

Hord silt loam, 0 to 1 percent slopes (Hd).—This is the only soil in the Hord series mapped in the county. It is on stream terraces. Included with this soil in mapping are small areas of Slickspots.

This soil is easy to till. The subsoil is moderately permeable to water, air, and roots, and it readily releases moisture to plants.

The main irrigated crop is corn, and the main dryland crops are grain sorghum and wheat. The soil is slightly acid, and lime is needed for alfalfa and soybeans. In irrigated areas maintaining fertility is a concern. Capability unit I-1, dryland, and I-1, irrigated; Silty Lowland range site; Silty to Clayey windbreak suitability group.

Lamo Series

The Lamo series consists of deep, somewhat poorly drained, nearly level soils on bottom lands of the Big Blue River and its tributaries. These soils formed in moderately fine textured sediment deposited by streams. They are commonly in areas that lack good drainage outlets.

In a representative profile the texture is silty clay loam throughout. The surface layer is dark gray and very dark gray and about 15 inches thick. The next layer is gray, hard when dry, firm when moist, and about 11 inches thick. The underlying material to a depth of 60 inches is gray and contains small lime concretions and a few, fine, distinct mottles of gray and yellowish brown. It is mildly alkaline.

Permeability of the Lamo soils is moderately slow. Available water capacity is high. Runoff is very slow. The average depth to the seasonal water table is 40 inches, but it fluctuates between 30 and 60 inches. It generally is high in spring and summer and low in fall and winter. These soils are occasionally flooded after high amounts of rainfall. They are suitable for crops commonly grown in the county during years of normal rainfall. Content of organic matter is moderate, and fertility is high.

The moderately high water table is somewhat beneficial to these soils. In years when rainfall is above normal, however, cultivation is restricted to better drained areas. Most areas of Lamo soils are cultivated, but some areas are in native grasses.

Representative profile of Lamo silty clay loam (in a cultivated field 300 feet east and 0.2 mile north of the southwest corner of sec. 9, T. 9 N., R. 2 E.):

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

A12—7 to 15 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) when moist; weak, medium, granular structure; slightly hard when dry, friable when moist; mildly alkaline; calcareous; clear, smooth boundary.

AC—15 to 26 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; mildly alkaline; calcareous; clear, smooth boundary.

C1—26 to 32 inches, gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) when moist; a few, fine, distinct mottles of gray and yellowish brown; moderate, medium, subangular blocky structure; hard when dry, firm when moist; mildly alkaline; calcareous; gradual, smooth boundary.

C2—32 to 46 inches, gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) when moist; weak, coarse, subangular blocky structure; hard when dry, firm when moist; mildly alkaline; calcareous; common medium concretions; gradual, smooth boundary.

C3—46 to 60 inches, gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) when moist; massive, very hard when dry, very firm when moist; mildly alkaline; calcareous; common, medium, lime concretions.

The A horizon ranges from 15 to 30 inches in thickness. It is silt loam to silty clay, but most areas are silty clay loam. It is gray to very dark gray in color and neutral to moderately alkaline in reaction. A gradual transition layer of gray to dark-gray silty clay loam is common to the C horizon. Deposits of sand and gravel on the side slopes of the bordering uplands add material that stratifies these soils.

These materials affect the water table and seepage conditions of these soils.

Lamo soils are near the Hobbs soils on bottom lands, the Hord and Hall soils on stream terraces, and Wet alluvial land. They have more clayey A and B horizons and a higher water table than do Hobbs soils. They are not so well developed and are not so well drained as Hord and Hall soils on the stream terraces. Lamo soils have a water table at a lower depth than that in Wet alluvial land.

Lamo silty clay loam (0 to 1 percent slopes) (Lb).—This is the only soil of the Lamo series mapped in the county. It is somewhat poorly drained and occurs on bottom lands. Included with this soil in mapping are areas of Slickspots that have a silty clay subsoil and that are moderately saline-alkali. These areas dry slowly after rains and limit tillage operations.

In seasons of high rainfall tillage is a concern, and crops are stunted because of denitrification and lack of aeration for plant roots. The gray underlying material is saturated with moisture for most of the year. In areas where outlets are available, excess water can be removed by open ditch or tile drains. Cultivation often is limited to the better drained areas. The water table may cause excessive wetness in some years, but during drier years it provides subirrigation that benefits crops.

Areas that have adequate drainage are suitable for corn, wheat, grain sorghum, and alfalfa. If spring planting is delayed, soybeans commonly are grown. Legumes are benefited by the lime in this soil. Surface drainage generally is needed in years when rainfall is above average. Fertility needs to be maintained. This soil is suited to growing trees in windbreaks. Capability unit IIw-4, dryland, and IIw-4, irrigated; Subirrigated range site; Moderately Wet windbreak suitability group.

Longford Series

The Longford series consists of deep, gently sloping to moderately sloping, well-drained soils on foot slopes adjoining bottom lands. They formed in light-brown to reddish-brown loess of the Loveland Formation.

In a representative profile the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is 32 inches thick. The upper 4 inches is dark grayish-brown silty clay loam. The next 21 inches is brown to reddish-brown silty clay which is very hard when dry and very firm when moist. The lower 7 inches is light reddish-brown silty clay loam. The underlying material is light-brown, moderately alkaline silty clay loam, and contains small lime segregations.

Permeability of these Longford soils is slow. Runoff is rapid. Fertility is medium and the content of organic matter is moderate. If cultivated, these soils are highly erodible on moderate slopes.

About half of the acreage of Longford soils is cultivated. These soils are suited to most crops commonly grown in the county.

Representative profile of Longford silty clay loam, 5 to 12 percent slopes, eroded (in a cultivated field 125 feet west and 0.15 mile north of the southeast corner of sec. 14, T. 11 N., R. 3 E.):

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

B1—8 to 12 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; medium acid; clear, smooth boundary.

B21t—12 to 22 inches, brown (7.5YR 5/2) silty clay, dark reddish gray (5YR 4/2) when moist; moderate, medium, prismatic structure that parts to strong, medium, blocky; very hard when dry, very firm when moist; slightly acid; thin discontinuous organic films on ped faces; clear, smooth boundary.

B22t—22 to 33 inches, reddish-brown (5YR 5/3) silty clay, reddish brown (5YR 4/3) when moist; moderate, coarse, prismatic structure that parts to moderate, coarse, blocky; very hard when dry, very firm when moist; neutral; gradual, smooth boundary.

B3—33 to 40 inches, light reddish-brown (5YR 6/3) silty clay loam, reddish brown (5YR 5/3) when moist; moderate, coarse, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; moderately alkaline; common segregations; gradual, smooth boundary.

C—40 to 60 inches, light-brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist; moderately alkaline; common small, lime segregations.

The A horizon ranges from 6 to 12 inches in thickness, from light silty clay loam to silty clay in texture, and from very dark gray to very dark grayish brown in color. The B horizon ranges from 24 to 34 inches in thickness and from silty clay to silty clay loam in texture. It is dark grayish brown to brown in the upper part and dark reddish brown to light reddish brown in the lower part. Reaction in the lower part is slightly acid to mildly alkaline. The C horizon contains small lime segregations in most places.

Soils of the Longford series are near the Geary, Hastings, and Sharpsburg soils. The Geary soils formed in reddish-brown loess of the Loveland Formation. The Hastings and Sharpsburg soils formed in pale-brown to yellowish-brown loess. Longford soils have a more clayey subsoil and less coarse material in the substratum than the Geary soils, and a more clayey subsoil than the Sharpsburg or Hastings soils.

Longford silty clay loam, 5 to 12 percent slopes, eroded (LonC2).—This is the only soil in the Longford series mapped in the county. It is well drained. The hazard of erosion is moderate to severe. Included with this soil in mapping are small severely eroded areas of Pawnee soils.

The clayey subsoil absorbs and releases moisture slowly for plants, and it is droughty during extended dry periods. Fertility of this soil is medium, but severely eroded areas are low in fertility.

About 70 percent of the acreage of this soil is cultivated. The main cultivated crops are grain sorghum and wheat. In severely eroded areas this soil is poor in tilth, low in fertility, and contains a clayey subsoil. Content of organic matter needs to be increased. This soil is suited to growing trees in windbreaks. Capability unit IVe-2, dryland; Clayey range site; Silty to Clayey windbreak suitability group.

Marsh

Marsh (M) consists of areas that have water on the surface to a depth of 1 to 12 inches for several months during years of normal rainfall. In years of normal rainfall the areas are covered with water the entire year, and in years of below normal rainfall they are covered for only 1 or 2 months. The size of marsh areas ranges from 30 to 120 acres.

Commonly, the surface layer of Marsh is gray silt loam to silty clay loam about 5 inches thick. The underlying material, about 30 inches thick, is dark-gray clay in the upper part and gray to light-gray silty clay in the lower part. Below this is light-gray silty clay loam that has distinct mottles of reddish brown.

Marsh has a dense claypan and is slowly permeable. As a result, most of the runoff received from surrounding higher areas is slowly lost by evaporation. Most areas of Marsh are near the center of large basins that lack good drainage outlets.

The vegetation on Marsh consists mostly of cattails, rushes, and sedges. Reeds, canarygrass, and willows grow in places along the outer edges of the areas. Most areas have a cover of plants; but in a few, small, intermittent lakes, little or no vegetation grows. Along the edges of these small lakes are fibrous remains of partly decomposed plants.

Marsh has a sparse cover of plants in spring even in years when rainfall is above normal. If the following fall and winter months are dry, part of the surface layer is lost because of soil blowing.

Marsh is well suited to providing food and cover for wetland wildlife. It generally is too wet for tillage, for livestock grazing, or for trees. Capability unit VIIIw-1, dryland; no range site assigned; Undesirable windbreak suitability group.

Meadin Series

The Meadin series consists of soils that are shallow over mixed sands and gravel. These moderately sloping to steep soils are on foot slopes along the Big Blue River and its tributaries. They are excessively drained and root growth is limited. Most areas of the Meadin soils are in perennial grasses or native vegetation.

In a representative profile the surface layer is dark-gray to dark grayish-brown loam (fig. 16), about 12 inches thick. Beneath this is a transition layer of very friable brown sandy loam about 6 inches thick. The underlying material is loamy sand to a depth of about 28 inches. This is underlain by coarse sand and fine gravel that is single grained and medium acid.

Permeability of these soils is rapid. Available water capacity is low. Content of organic matter is low. Because of the coarse-textured underlying material, these soils are droughty during dry seasons. Much of the fertility has been leached below the depth of most plant roots, and only limited amounts of moisture are available for crop use. In areas where these soils are not protected, moderate to severe erosion has removed the surface layer and has left coarse gravelly material on the surface.

Most areas of this soil are in permanent grass. Small areas are cultivated where they are a part of larger areas of deep finer textured soils.

Representative profile of Meadin loam from an area of Meadin soils, 7 to 31 percent slopes, eroded (in pasture 50 feet east and 0.45 mile north of the southwest corner of sec. 9, T. 9 N., R. 2 E.):

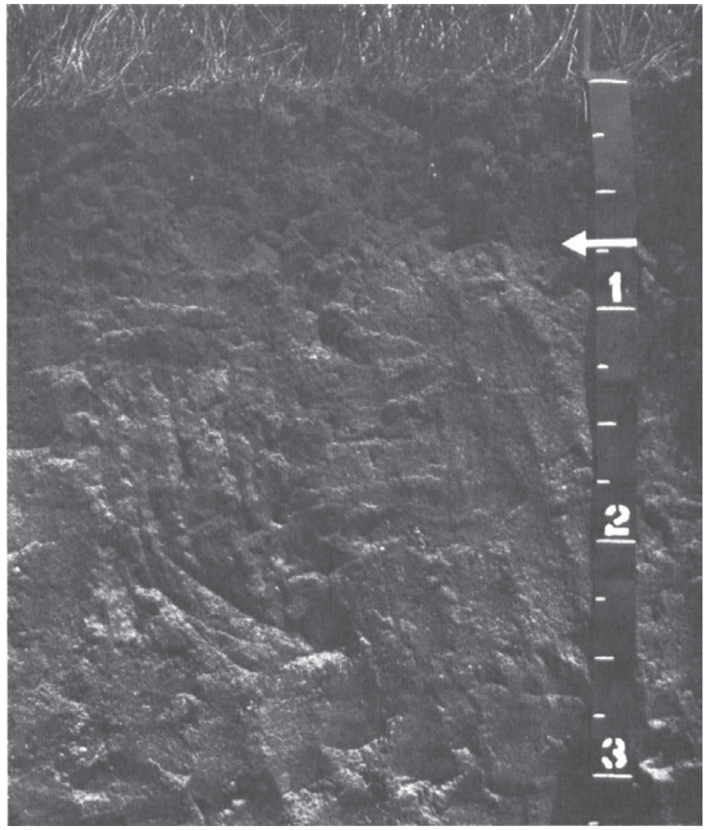

***Figure 16.*—Profile of a Meadin soil that has a loam surface layer and coarse sand and gravel underlying material. Available water capacity of this soil is low.**

A11—0 to 5 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry; friable when moist; slightly acid; clear, smooth boundary.

A12—5 to 12 inches, dark grayish-brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure that parts to weak, medium, granular; soft when dry; very friable when moist; slightly acid; clear, smooth boundary.

AC—12 to 18 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure that parts to single grained; soft when dry, very friable when moist; slightly acid; gradual, smooth boundary.

IIC1—18 to 28 inches, yellowish-brown (10YR 5/4) loamy sand, dark yellowish brown (10YR 4/4) when moist; single grained; loose; medium acid; gradual, smooth boundary.

IIC2—28 to 50 inches, very pale brown (10YR 7/3) coarse sand and fine gravel, pale brown (10YR 6/3) when moist; single grained; loose; medium acid.

The A horizon ranges from loam to loamy sand and from dark grayish brown to dark gray. The AC horizon is a gradual transition of sandy loam or loamy sand to the coarse sandy and gravelly material in the substratum. The depth to loamy sand or sand and gravel ranges from 12 to 20 inches. In severely eroded areas the content of organic matter is low, and a very limited amount of moisture is available for plants. Reaction throughout the profile ranges from strongly acid to neutral. Coarse gravel is scattered on the surface.

Meadin soils are near the Geary and Longford soils which formed in reddish-brown loess. Meadin soils have a coarser textured surface layer and are shallow over sandy and gravelly material. Meadin soils have a coarser textured profile than Longford soils, which have a deep profile and a clayey subsoil.

Meadin soils, 7 to 31 percent slopes, eroded (M1D2).—This is the only mapping unit of the Meadin series mapped in the county. These excessively drained soils are mostly on foot slopes of uplands that border bottom lands.

The surface layer of these soils ranges from loam to loamy sand. Included with these soils in mapping are small areas of Geary soils.

Nearly all of the acreage is in native grasses or has been reseeded to perennial grasses. A few moderately sloping areas are cultivated where they are a part of larger units of deeper, finer textured soils. The soils in this mapping unit are suitable for growing certain kinds of trees in windbreaks and for use by wildlife. Improving the stand of grasses is the main concern on these soils. These soils are too droughty for cultivated crops. Capability unit VIs–4, dryland; Shallow to Gravel range site; Shallow windbreak suitability group.

Morrill Series

The Morrill series consists of deep, moderately sloping, well-drained soils that formed in weathered and leached reworked till.

In a representative profile the surface layer is dark grayish-brown clay loam about 11 inches thick. The subsoil is clay loam about 27 inches thick. The upper part is dark brown, the middle part is brown, and the lower part is reddish brown. It is hard when dry and firm when moist. The substratum is brown sandy clay loam in the upper 14 inches and brown sandy loam in the lower part with pockets of coarse sand and gravel in some areas.

Permeability of these soils is moderately slow. Available water capacity is high. Fertility is medium, and the content of organic matter is moderate. The surface layer is slightly acid, and lime is leached to a depth below 60 inches.

Most areas of the Morrill soils are cultivated. Lime is needed for legumes. These soils are easy to till. Many areas that are severely eroded have been reseeded to tame pastures.

Representative profile of Morrill clay loam, 7 to 12 percent slopes, eroded (in a cultivated field 0.2 mile north and 0.3 mile west of the southeast corner, sec. 1, T. 12 N., R. 4 E.):

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, granular, structure; slightly hard when dry, friable when moist; slightly acid; abrupt, smooth boundary.

A12—6 to 11 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) when moist; weak, medium, crumb structure; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B21t—11 to 21 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 4/3) when moist; moderate, coarse and medium, subangular blocky structure; hard when dry, firm when moist; slightly acid; clear, smooth boundary.

B22t—21 to 30 inches, brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) when moist; weak, coarse, prismatic structure that parts to moderate, coarse, subangular blocky; hard when dry, firm when moist; slightly acid; clear, smooth boundary.

B3—30 to 38 inches, reddish-brown (5YR 4/3) clay loam, brown (7.5YR 5/2) when moist; weak, coarse, prismatic structure that parts to weak, medium, subangular blocky; hard when dry, firm when moist; neutral; gradual, smooth boundary.

C1—38 to 52 inches, brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) when moist; weak, coarse, prismatic structure that parts to weak, fine, subangular blocky; slightly hard when dry, firm when moist; neutral; gradual, smooth boundary.

C2—52 to 65 inches, brown (7.5YR 5/4) sandy loam, brown (7.5YR 4/4) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist; neutral.

The A horizon ranges from 8 to 14 inches in thickness. It is clay loam to loam in texture and dark grayish brown to dark brown in color. Small stones and coarse pebbles are scattered on the surface in areas that are severely eroded. The B horizon ranges from heavy clay loam to sandy clay loam in texture and from dark brown to reddish brown in color. Reaction throughout the profile ranges from medium acid to neutral.

Morrill soils are near the Burchard, Geary, Shelby, and Steinauer soils. The Morrill soils contain more acid in the C horizon and more coarse material than soils of the Burchard, Shelby, and Steinauer series which also formed in till. Unlike the Geary soils the Morrill soils formed in till, and they have more coarse sand and gravel in the C horizon.

Morrill clay loam, 7 to 12 percent slopes, eroded (MrC2).—This is the only unit of the Morrill series mapped in the county. It is well drained and on till uplands. This soil formed in reddish-brown reworked till on the upper parts of side slopes. The side slopes occurring are mostly in narrow bands between soils formed in loess and those formed in limy till. Surface runoff is rapid.

Included with this soil in mapping are small areas of soils that have a sandy surface layer, subsoil, and underlying material.

This soil is cultivated except for a few small areas of native grasses. Eroded areas lack organic matter and need crop residue on the surface. Soil erosion and soil blowing are the main hazards. Some severely eroded areas are stabilized by reseeding to native perennial grasses. Fertility and tilth need to be improved and maintained. This soil is well suited to growing trees in windbreaks. Grain sorghum and small grains are best suited to cultivated crops. Capability unit IIIe–1, dryland, and IVe–1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Pawnee Series

The Pawnee series consists of deep, gently sloping to moderately sloping soils on uplands. They are moderately well drained and formed in glacial till.

In a representative profile the surface layer is mainly dark-gray clay loam about 10 inches thick. A few small stones and coarse pebbles are scattered on the surface. The subsoil is about 29 inches thick. The upper part is grayish-brown dense clay which shrinks and cracks upon drying (fig. 17). The lower part is brown heavy clay loam, which is very hard when dry and very firm when moist. The yellowish-brown underlying till is of clay loam texture and contains pockets and seams of soft lime and many medium, dark reddish-brown segregations.

Permeability of the Pawnee soils is slow, and the available water capacity is moderate. Reaction is slightly acid in the surface layer and moderately alkaline in the underlying till. Fertility is medium to low, and the content of organic matter is moderate.

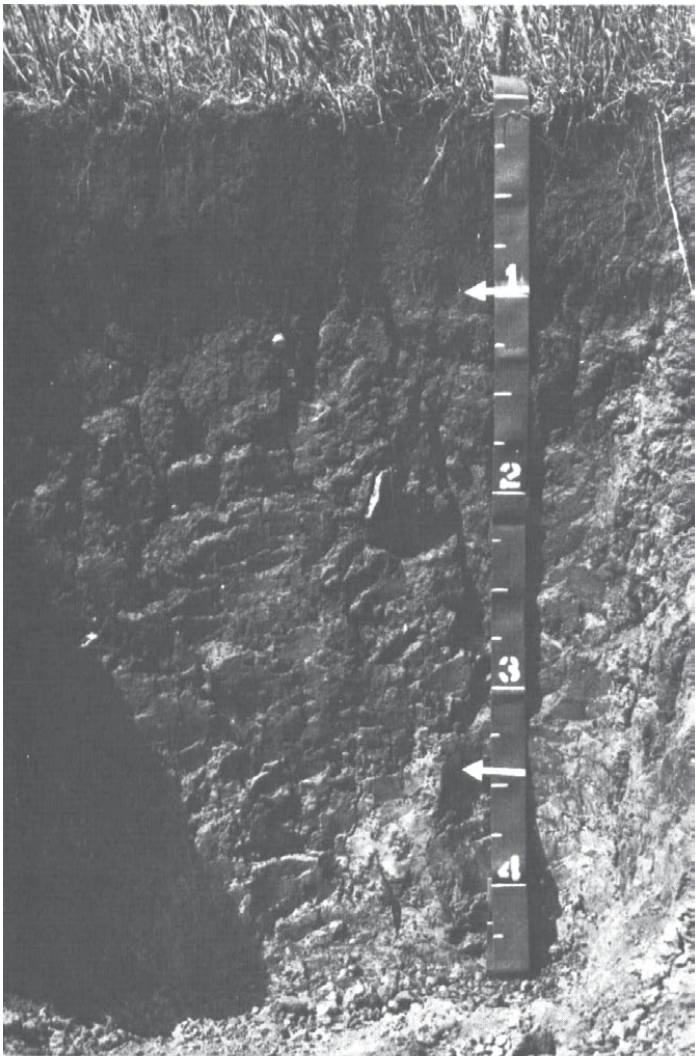

Figure 17.—**Profile of a Pawnee clay loam. The clayey subsoil has strong blocky structure and cracks badly upon drying.**

Most areas of Pawnee soils are cultivated. Most severely eroded and gullied areas are in permanent vegetation of native and tame grasses.

Representative profile of Pawnee clay loam, 3 to 7 percent slopes, eroded (in a cultivated field 100 feet south and 264 feet west of the northeast corner of sec. 23, T. 9 N., R. 4 E.):

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

A3—6 to 10 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, subangular blocky structure; hard when dry; firm when moist; slightly acid; clear, smooth boundary.

B21t—10 to 21 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure that parts to strong, coarse, blocky; very hard when dry, very firm when moist; few small pebbles and stones; neutral; clear, smooth boundary.

B22t—21 to 30 inches, grayish-brown (10YR 5/2) clay, dark brown (10YR 4/3) when moist; moderate, coarse, prismatic structure that parts to strong, medium, blocky; very hard when dry, very firm when moist; few small pebbles and stones; neutral; clear, smooth boundary.

B3—30 to 39 inches, brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) when moist; weak, coarse and moderate, medium blocky structure; very hard when dry, very firm when moist; few small pebbles and stones; calcareous; mildly alkaline; a few small iron segregations and lime concretions; common, medium, distinct, reddish-brown stains; clear, smooth boundary.

C—39 to 60 inches, yellowish-brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, subangular blocky structure; hard when dry, firm when moist; few small and medium pebbles and stones; calcareous; moderately alkaline; disseminated lime in medium masses; many medium, dark reddish-brown segregations.

The A horizon ranges from 4 to 14 inches in thickness. It ranges from clay loam to loam in texture, and from dark grayish brown to dark gray in color. The B horizon is 25 to 36 inches thick. The B3 horizon ranges from heavy clay loam to clay. In most places lime is in the lower part of the B horizon, and a few small pebbles and stones are scattered throughout the B horizon. The till in the C horizon commonly contains reddish-brown and yellowish-brown stains and a few small and medium pebbles and stones.

Pawnee soils are near the Burchard, Morrill, Shelby, and Steinauer soils. Pawnee soils have a more clayey B horizon than Burchard and Shelby soils. The lime in Pawnee soils is leached to a lower depth than in Steinauer soils, but both soils formed in similar calcareous glacial till. Pawnee soils are not so reddish brown in the solum, but are more clayey in the B and C horizons than the Morrill soils.

Pawnee clay loam, 3 to 7 percent slopes (PwB).—This moderately well drained soil is on ridgetops and upper parts of minor drainageways. Its surface layer is thicker than that described as representative of the series. Erosion and gully formation are slight. Included with this soil in mapping are small areas of Longford soils that have a reddish-brown subsoil.

Erosion and runoff are the main hazards. The clayey subsoil is slowly permeable, and it absorbs and releases water slowly to plants. Runoff is medium. The lowest part of the subsoil and the underlying till contain moderate amounts of lime available to crops.

Most of this soil is in native grasses. The soil is suited to growing trees in windbreaks. Capability unit IIIe-2, dryland, and IIIe-2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Pawnee clay loam, 3 to 7 percent slopes, eroded (PwB2).—This soil has the profile described as representative for the series. It is moderately well drained and is on rounded ridges and upper side slopes of minor drainageways.

Included with this soil in mapping are small areas of soils that have a reddish-brown subsoil. Also included are a few areas that lack lime to a depth of 50 inches.

The soil is very firm when moist and very hard when dry. It is slowly permeable to water, roots, and air. The lower part of the subsoil and the underlying till contain pockets and seams of lime that is available for crops. In cultivated areas sheet erosion is a hazard. Because the subsoil absorbs and releases water slowly to plants, this soil is droughty during extended dry periods. Fertility is medium, and content of organic matter is moderate.

Nearly all of the acreage of this soil is cultivated. The main crops are grain sorghum and small grains which are commonly rotated with alfalfa. This soil lacks the lime needed in the surface soil for establishing legumes; but within 2 years after planting, the crop roots extend into the lower part of the subsoil and underlying till where lime is in adequate supply. The main concerns of management are controlling erosion and maintaining fertility. This soil is suited for growing trees in windbreaks. Capability unit IIIe-2, dryland, and IIIe-2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Pawnee clay loam, 7 to 12 percent slopes (PwD).—This moderately well drained soil is on the upper parts of side slopes to drainageways. This soil has a slightly thinner subsoil and has lime higher in the profile than the profile described as representative for the series. A few small pebbles and stones are on the surface.

Available water capacity is moderate and runoff is medium. Gully erosion is a hazard where the surface soil is unprotected. This soil is slowly permeable, and it absorbs and releases water slowly to plants. Fertility is medium, and the content of organic matter is moderate. The underlying till contains pockets and seams of soft lime that is available for crops.

This soil is mostly in native grasses and is used for grazing and hay. A few gullies have formed in overgrazed areas. The main concern of management is improving the quality and quantity of grasses. Controlling runoff to prevent gulleys from forming and to control water erosion are concerns in cultivated areas. Trees grow well in windbreaks. Capability unit IVe-2, dryland; Clayey range site; Silty to Clayey windbreak suitability group.

Pawnee clay loam, 7 to 12 percent slopes, eroded (PwD2).—This soil has a thinner and lighter colored surface layer than that described as representative for the series. It also is less acid and lower in fertility. Included with this soil in mapping are small, severely eroded areas that have small stones and coarse pebbles scattered on the surface.

This soil is slowly permeable to water, roots, and air. It is very firm when moist and very hard when dry. In cultivated areas sheet erosion is a hazard. The surface layer contains a moderate amount of organic matter. The lower part of the subsoil and the underlying till contain varying amounts of lime. This soil is droughty during extended dry periods.

About three-fourths the acreage of this soil is cultivated. The soil is better suited to closely grown small grains than to other crops. Some areas have been reseeded to permanent grasses or bromegrass. Controlling water erosion and improving the content of organic matter and soil tilth are the main concerns of management. Trees can grow in windbreaks. Capability unit IVe-2, dryland; Clayey range site; Silty to Clayey windbreak suitability group.

Pawnee soils, 3 to 7 percent slopes, severely eroded (PaB3).—These soils are on ridges and the upper parts of side slopes along minor drainageways. Most of the original topsoil has been removed by erosion.

The surface layer ranges from clay loam to clay. It is finer textured, lighter colored, and less fertile than that described as representative for the series. Included with these soils in mapping are small areas of Wymore soils near the upper parts of drainageways and on ridgetops.

The surface layer is very sticky when wet and very hard when dry and is low in organic matter. Small stones and coarse pebbles are on the surface. In cultivated areas the upper part of the subsoil is mixed with the surface layer. The clayey subsoil is slowly permeable, and it absorbs and releases water slowly to plant roots. The underlying till has a moderate amount of lime available for most crops.

Because of the severe hazard of erosion, poor tilth, and a dense subsoil, these soils are better suited to sorghum and small grains than to other crops. They lack the lime needed when establishing new seedings of alfalfa and bromegrass. Water erosion is a hazard. Tilth needs to be improved by adding organic matter. Trees in windbreaks are suited to these soils. Capability unit IVe-4, dryland; Dense Clay range site; Silty to Clayey windbreak suitability group.

Pawnee soils, 7 to 12 percent slopes, severely eroded (PaC3).—These soils are on uplands. Most of the original surface layer has been washed away by sheet erosion. Some gullies formed in the upper parts of drainage systems.

These soils are lighter in color and finer in texture, are less fertile, and have a thinner surface layer than that described as representative for the series. Texture of the surface layer ranges from clay loam to clay. They also have a thinner subsoil, and lime is within a depth of 24 inches. Included with these soils in mapping are some areas of large gullies which are eroding.

The upper part of the subsoil has been mixed with the surface layer by cultivation. Small pebbles and stones are on the surface. Tillage is difficult because the surface layer is very sticky when wet and very hard when dry. The dense clayey subsoil is slowly permeable, and it absorbs and releases water slowly to plants. The lower part of the subsoil and the underlying till contain seams and old root channels filled with soft lime.

Because of the severe hazard of erosion, poor tilth, and rapid runoff, these soils mostly are limited to mixtures of native grasses. Controlling water erosion and soil blowing and increasing fertility are the major concerns of management. Trees in windbreaks are suited to this soil. Capability unit VIe-4, dryland; Dense Clay range site; Silty to Clayey windbreak suitability group.

Rough Broken Land, Loess

Rough broken land, loess, (31 to 75 percent slopes) (RB) is on upland drainageways (fig. 18). It occurs as abrupt breaks, deep gullies, bluffs, canyons, and areas of catsteps. Runoff is very rapid, and water erosion ranges from slight to very severe.

The very dark brown to dark grayish-brown surface layer is about 3 to 7 inches in thickness and silty clay loam to silt loam in texture. Reaction is neutral to mildly alkaline, and content of organic matter and fertility are low. The underlying material is friable, silty, pale-brown to light reddish-brown loess. Outcrops of coarse sandy and gravelly material occur in places.

Permeability is moderate to moderately slow. Erosion is slight to severe depending upon the amount of vegetative cover. In severely eroded areas small hard lime concretions are at or near the surface. Included in this

Figure 18.—**Rough broken land, loess on very steep slopes. Gullies are common.**

land type are small narrow areas of bottom land along drainageways.

Most areas of this land type are in permanent grasses, shrubs, and trees, but they are better suited for grazing and wildlife habitat.

Deciduous trees and small shrubs are common near the lower end of the drainageways. In some areas are large gullies and overfalls in the drainageways. Preventing erosion and gullying are the main concerns. Capability unit VIIe–1, dryland; Thin Loess range site; Undesirable windbreak suitability group.

Rough Broken Land, Till

Rough broken land, till, (31 to 75 percent slopes) (RBg) occurs along Oak Creek and Middle Creek and their tributaries. This land type contains large gullies and overfalls in areas of active gully erosion. In some places rocks and boulders are on the surface. Erosion ranges from slight to severe, and runoff is very rapid.

The surface layer is about 4 to 7 inches thick. It is clay loam to loam in texture and very dark gray to dark grayish brown in color. It is low in content of organic matter and fertility and is mildly alkaline to moderately alkaline. The underlying till is grayish-brown to yellowish-brown clay loam that contains a few small rocks and stones scattered throughout the profile. Lime is abundant in pockets and seams. Reddish-brown iron stains are common. Included with this land type in mapping are small, narrow, irregular areas of bottom lands along drainageways.

Nearly all areas of this land type are in permanent grasses, shrubs, and trees. The deciduous trees consist mostly of oak, ash, hackberry, elm, and maple. Some buck brush is present. This land type is suitable for grazing, timber, and wildlife habitat.

A protective cover of grasses is needed to control erosion and runoff. Overfalls and gully erosion are hazards in this land type. Capability unit VIIe–1, dryland; Limy Upland range site; Undesirable windbreak suitability group.

Scott Series

The Scott series consists of deep, very poorly drained soils in large depressions and in basins throughout the uplands. Scott soils are covered with water for several months during years of above average rainfall. Some of the lowest areas are nearly barren.

In a representative profile the surface layer is about 7 inches thick. The upper part is gray silt loam, and the lower part is light-gray silt loam. The subsoil is 26 inches thick and very sticky when wet and very hard when dry. The upper part is dark-gray silty clay and the middle part is gray and olive-gray very firm clay. The lower part is light-gray silty clay loam. The underlying material is light-gray silty clay loam that contains a few, faint, reddish-brown stains. Lime is leached to a depth of more than 60 inches.

Permeability of the Scott soils is very slow, and available water capacity is moderate. Fertility is medium, and the content of organic matter is low. Reaction is medium acid in the surface layer. Because most of the large basins are without a good drainage outlet, these soils are often ponded with excess water during the spring and summer months. The water is removed slowly by seepage and evaporation.

Scott soils are mainly used for pasture or range. They have some limited use for cultivated crops during drier years. Because they are covered by water during much of the growing season, grain crops are not grown except where tile drains, dugouts, or large drainage ditches remove excess water. A few large basins without drainage are developed for recreational use.

Representative profile of Scott silt loam (in range 100 feet west and 1,056 feet south of the northeast corner of sec. 32, T. 11 N., R. 1 E.):

A1—0 to 4 inches, gray (10YR 5/1) silt loam; very dark gray (10YR 3/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; medium acid; clear, smooth boundary.

A2—4 to 7 inches, light-gray (10YR 6/1) silt loam, dark gray (10YR 4/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; medium acid; abrupt, smooth boundary.

B21t—7 to 12 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10 3/1) when moist; moderate, coarse, blocky structure that parts to strong, medium, blocky; very hard when dry, very firm when moist; slightly acid; clear, smooth boundary.

B22t—12 to 20 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) when moist; moderate, medium, prismatic structure that parts to strong, coarse, blocky; very hard when dry, very firm when moist; slightly acid; clear, smooth boundary.

B23t—20 to 26 inches, olive-gray (5Y 5/2) clay, olive gray (5Y 4/2) when moist; moderate, coarse, prismatic structure; very hard when dry, very firm when moist; neutral; many, medium, distinct, reddish-brown stains; clear, smooth boundary.

B3—26 to 33 inches, light-gray (5Y 6/1) silty clay loam, gray (5Y 5/1) when moist; moderate, coarse, prismatic structure that parts to moderate, medium, subangular blocky; very hard when dry, very firm when moist; neutral; a few, faint, reddish-brown stains; gradual, smooth boundary.

C—33 to 60 inches, light-gray (5Y 7/2) silty clay loam, olive gray (5Y 5/2) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist; neutral; a few, faint, reddish-brown stains.

The A horizon ranges from 4 to 10 inches in thickness. The A1 horizon ranges from very dark gray to gray in color. The B horizon ranges from 25 to 34 inches in thickness. The C horizon ranges from silt loam to silty clay loam in texture and from olive gray to light gray in color.

In the larger basins these soils have a thinner A horizon, a darker B horizon, and a lower content of organic matter.

Scott soils are near the Butler and Fillmore soils. They have a thinner A horizon, and lime is at a lower depth than the Fillmore soils. They occur at lower positions in depressions and are flooded for longer periods than Fillmore soils. Scott soils have a thinner A horizon than Butler soils that are not ponded.

Scott silt loam (0 to 1 percent slopes (Sc).—This is the only soil in the Scott series mapped in the county. It is in basins or large depressions which are covered with water for several months after a high amount of rainfall. The dense claypan subsoil is very slowly permeable to roots, air, and water.

Frequent ponding limits the use of this soil for cultivated crops. In some areas are large dugouts or pits, tile drains, and deep ditches to improve the drainage so that cultivated crops can be grown. Where drained this soil is farmed with the adjoining fields. The dense clayey subsoil absorbs and releases water slowly to plants. In areas without drainage vegetation consists mostly of sedges, prairie cordgrass, and smartweeds. Excess surface water is the main hazard on this soil. Soil tilth needs to be improved if the soil is cultivated. Capability unit IVw–2, dryland, and IVw–2, irrigated; range site not assigned; Undesirable windbreak suitability group.

Sharpsburg Series

The Sharpsburg series consists of deep, well-drained, gently sloping to strongly sloping soils. These soils formed in silty Peoria loess on uplands. They are on ridgetops, on the upper parts of side slopes, and on the lower concave areas next to drainageways.

In a representative profile the surface layer is mainly dark-gray silty clay loam about 8 inches thick. The subsoil is about 27 inches thick. The upper part is dark-brown silty clay loam, which is firm when moist and hard when dry. The lower part is brown silty clay loam (fig. 19). The underlying loess material is pale-brown silt loam and is mildly alkaline.

Permeability of the Sharpsburg soils is moderately slow. Available water capacity is high, and these soils

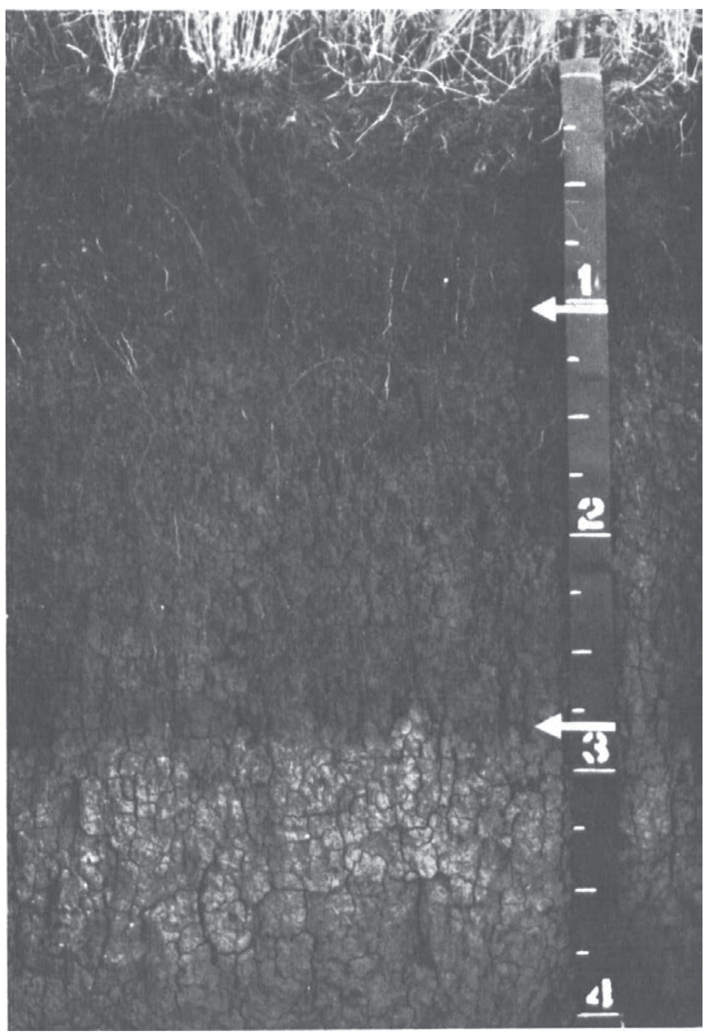

Figure 19.—**Profile of Sharpsburg silty clay loam. This soil formed in Peoria loess and has subangular blocky structure in the subsoil.**

release moisture readily to plants. Where cultivated these soils are erodible on steeper slopes. Soils of the Sharpsburg series are medium in fertility and contain a moderate amount of organic matter. Severely eroded areas, however, are low in fertility and organic matter.

These soils are used for cultivated crops and for range. They are better suited to permanent vegetation on strong slopes than other crops. They are easy to till. Many severely eroded areas and steep areas are seeded to perennial grasses.

Representative profile of Sharpsburg silty clay loam, 3 to 7 percent slopes, eroded (in a cultivated field 200 feet south and 0.45 mile west of northeast corner of sec. 11, T. 10 N., R. 4 E.):

Ap—0 to 5 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; medium acid; abrupt, smooth boundary.

A12—5 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, medium, granular; hard when dry, firm when moist; medium acid; clear, smooth boundary.

B1t—8 to 12 inches, dark-brown (10YR 4/3) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse and fine, subangular blocky structure; hard when dry, firm when moist; slightly acid; clear, smooth boundary.

B21t—12 to 19 inches, dark-brown (10YR 4/3) heavy silty clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; slightly acid; gradual, smooth boundary.

B22t—19 to 29 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B3—29 to 35 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, coarse and medium, subangular blocky structure; hard when dry, firm when moist; neutral; a few fine, faint yellowish-brown stains; gradual, smooth boundary.

C—35 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; slightly hard when dry, friable when moist; mildly alkaline.

The A horizon ranges from 4 to 15 inches in thickness. It is silt loam to silty clay loam in texture, and dark gray to dark grayish brown in color. This horizon is friable but is firm on severely eroded areas. Reaction is medium acid to neutral.

The B horizon ranges from 15 to 30 inches in thickness. It is silty clay loam to light silty clay in texture and dark brown to grayish brown in color.

The C horizon ranges from silt loam to silty clay loam and is pale brown to brown. Except in severely eroded areas, it is without lime concretions to a depth of 60 inches. The mantle of Peoria loess ranges from 3 to 15 feet in thickness and overlies gray to reddish-gray material that contains many reddish-brown stains. Beneath this is calcareous till.

Sharpsburg soils are near the Burchard, Geary, Pawnee, and Wymore soils. They have a less clayey B horizon and formed in a thicker mantle of loess than the Wymore soils. Sharpsburg soils have a moderately fine textured B horizon and developed in loess, whereas Pawnee soils have clayey B horizons and like Burchard soils formed in till. Unlike Geary soils that have a reddish-brown subsoil, Sharpsburg soils have a brown subsoil.

Sharpsburg silty clay loam, 3 to 7 percent slopes, eroded (ShB2).—This soil has the profile described as representative for the Sharpsburg series. It is a well-drained soil on ridgetops. Areas of this soil range from 10 to 60 acres. Included with this soil in mapping are a few somewhat poorly drained areas too small to be mapped separately.

Permeability of this soil is moderately slow. Available water capacity is high, and this soil releases moisture readily to plants. Fertility is medium and the content of organic matter is moderate. Runoff is medium.

Most areas of this soil are cultivated. This soil is well suited to all crops commonly grown in the county, and areas that are dryfarmed are mainly in corn, grain sorghum, and wheat. Lime is needed to establish legumes. Erosion and soil blowing are the main hazards. Fertility needs to be maintained at a high level. Trees are well suited to windbreaks. Capability unit IIIe-11, dryland, and IIIe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Sharpsburg silty clay loam, 7 to 12 percent slopes, eroded (ShD2).—This well-drained soil is on the upper parts of side slopes and on concave foot slopes along drainageways in uplands. The surface layer and subsoil of this soil are slightly thinner than that described as representative for the series. Included with this soil in mapping are small areas of Geary and Longford soils.

Permeability of this soil is moderately slow, and fertility is medium. Moisture is readily available to plants, and this soil is easy to till. Runoff is medium.

This soil is well suited to most crops. Grain sorghum, wheat, and corn are grown in a cropping system with alfalfa. Water erosion is a hazard when farming this soil. The main concerns of management in irrigation areas are maintaining fertility and managing water. This soil is suited to growing trees in windbreaks. Capability unit IIIe-1, dryland, and IVe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Sharpsburg silty clay loam, 3 to 7 percent slopes, severely eroded (ShB3).—The profile of this soil has a thinner surface layer and subsoil than that described as representative for the series. In many places the subsoil is mixed with the surface layer during tillage. This mixing results in a lighter colored surface layer than that in the representative profile. This well-drained soil is on ridges and the upper parts of side slopes on uplands. Most of the original surface layer has been removed by erosion. Included with this soil in mapping are small areas of Wymore soils.

Permeability of this soil is moderately slow. Because of severe erosion this soil is low in fertility and in content of organic matter. Runoff is medium. Rills and small gullies form in fields that are clean tilled during rains of high intensity. Improving and maintaining fertility are necessary.

Most of the acreage of this soil is cultivated. Suitable crops are corn, grain sorghum, and small grains. Severely eroded areas are stabilized by reseeding to native or perennial grasses. This soil is suited to growing trees in windbreaks. Capability unit IIIe-81, dryland, and IIIe-11, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Sharpsburg silty clay loam, 7 to 12 percent slopes, severely eroded (ShD3).—This well-drained soil is on narrow upland ridges and moderate side slopes of drainageways in the Oak Creek and Middle Creek drainage area. Most of the original darkened surface layer has been removed by erosion.

This soil has a thinner surface layer and subsoil than that in the profile described as representative for the series. Because of mixing of the surface layer with the subsoil during cultivation, the surface layer is also lighter in color and the substratum is more gray than that described as representative. The substratum contains reddish-brown stains directly above the finer textured underlying layers of glacial till.

Permeability of this soil is moderately slow. Fertility and the content of organic matter are low, but available water capacity is high. Rapid runoff and severe water erosion are the main hazards in farming this soil.

This soil is better suited to close-growing crops and tame pasture than to other crops. Alfalfa, clover, and wheat are the main crops, and a small acreage is in grain sorghum. If they are reseeded to perennial grasses, areas of gullies and rills are protected from further erosion. This soil is suited to growing trees in windbreaks. Capability unit IIIe–82, dryland, and IVe–11, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded (ShE3).—This well-drained soil is on uplands of the Oak Creek and Middle Creek drainage area.

The profile of this soil contains a thinner surface layer and subsoil than that in the profile described as representative for the series. Also, the depth to finer textured till is less than that in the representative profile. In cultivated areas the upper part of the subsoil is mixed with the surface layer, and this results in a lighter colored surface layer that is lower in content of organic matter. The substratum is darker and in many places contains small lime concretions and reddish-brown mottles.

Included with this soil in mapping are small areas of light-brown loess and till material and a few very steep drainageways and gullies.

Permeability of this soil is moderately slow, and the soil releases moisture readily to plants and is easily penetrated by roots. Runoff is rapid. The hazard of erosion is severe. Rills and small gullies are common on fields where erosion is not controlled.

Many of the cultivated areas of this soil are part of larger moderately sloping areas. Because of the strong slopes, the severe hazard of erosion, and the limitations on the use of large machinery, this soil is better suited to perennial grasses and legumes than other crops. The steeper areas along drainageways and gullies are mostly in trees and shrubs. Capability unit IVe–8, dryland; Silty range site; Silty to Clayey windbreak suitability group.

Shelby Series

The Shelby series consists of deep, gently sloping to moderately sloping, well-drained soils that are mostly on the lower parts of side slopes to upland drainageways. These soils formed in glacial till.

In a representative profile the surface layer is mainly dark-gray clay loam about 10 inches thick. The subsoil is about 25 inches thick. It is clay loam that is slightly hard when dry and firm when moist. It is dark grayish-brown in the upper part and brown in the lower part. The light brownish-gray underlying material is clay loam that contains lime at a depth of about 35 inches. Reddish-brown stains are common. Few small pebbles and stones are throughout the profile.

Permeability of these soils is moderately slow. Available water capacity is high, content of organic matter is moderate, and fertility is medium.

About half of the acreage of Shelby soils is cultivated. The remaining acreage is in native grasses and tame pastures.

Representative profile of Shelby clay loam, 7 to 12 percent slopes (in native grasses 300 feet south and 0.45 mile west of the northeast corner of sec. 2, T. 12 N., R. 4 E.):

A11—0 to 6 inches, dark-gray (10YR 4/7) clay loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; few small pebbles and stones; slightly acid; clear, smooth boundary.

A12—6 to 10 inches, very dark gray (10YR 3/1) clay loam, black (10YR 2/1) when moist; weak, coarse and medium, granular structure; slightly hard when dry, friable when moist; few small pebbles and stones; slightly acid; clear, smooth boundary.

B1—10 to 16 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and fine, subangular blocky structure; slightly hard when dry, firm when moist; few small pebbles and stones; neutral; clear, smooth boundary.

B2t—16 to 25 inches, yellowish-brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; slightly hard when dry, firm when moist; few small pebbles and stones; neutral; clear, smooth boundary.

B3t—25 to 35 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure that parts to weak, coarse, subangular blocky; slightly hard when dry, firm when moist; few small pebbles and stones; neutral; abrupt, smooth boundary.

Cca—35 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) when moist; massive; slightly hard when dry, firm when moist; few small and medium pebbles and stones; moderately alkaline; common, medium, distinct reddish-brown stains; many pockets of lime.

The A horizon ranges from 5 to 15 inches in thickness, from clay loam to loam in texture, and from dark gray to very dark brown in color.

The B horizon ranges from 20 to 30 inches in thickness and from clay loam to light clay in texture. Depth to lime ranges from 30 to 50 inches.

The C horizon has pockets of soft white lime that contain some iron stains and relic mottles.

Soils of the Shelby series formed in glacial till similar to that of the Burchard, Pawnee, and Steinauer soils. Shelby soils are less clayey in the B horizon than the Pawnee soils. Unlike Shelby soils, the Burchard and Steinauer soils contain lime within a depth of 30 inches and have a thinner solum. Shelby soils formed in till and Wymore soils formed in loess.

Shelby clay loam, 7 to 12 percent slopes (SkC).—This soil has the profile described as representative for the Shelby series. It is well drained and is in till on the uplands, mostly on concave areas. A few areas are on lower ridgetops. Included with this soil in mapping are small areas of Burchard soils next to drainageways.

Permeability is moderately slow. Available water capacity is high, and moisture is released readily to plants.

In some overgrazed pastures gullies form in natural drainageways. Runoff is medium.

Most areas of this soil are small and are closely associated with steeper soils of the Burchard and Steinauer series. This soil is mostly in native grasses. The main concerns of management are soil erosion, gullying, and conservation of surface water. This soil is suited to growing trees in windbreaks. Capability unit IIIe-1, dryland, and IVe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Shelby clay loam, 5 to 12 percent slopes, eroded (SkC2).—The profile of this soil has a surface layer and subsoil that are slightly thinner than those in the profile described as representative for the series. Lime is not so deep and in many places occurs at a depth of 32 to 40 inches. This well-drained soil is in areas that border drainageways and valley sides in till on the uplands in the Oak Creek and Middle Creek drainage area.

Included with this soil in mapping are small areas of loamy till material along the lower slopes of the Oak Creek and Middle Creek drainage area.

Permeability is moderately slow. Available water capacity is high, and moisture is released readily to plants. This soil is easy to till, and content of organic matter needs to be improved. Runoff is medium. The hazard of erosion is moderate, and the main concern of management is the control of erosion. Because this soil lacks some nutrients, maintaining fertility also is a concern.

Most of this soil is cultivated. It is well suited to most crops grown in the county. This soil is well suited to growing tame grasses, to trees in windbreaks, and for use by wildlife. Grain sorghum, wheat, corn, and alfalfa are the main crops. Lime in the underlying till is adequate for most legumes. Capability unit IIIe-1, dryland, and IVe-1, irrigated; Silty range site; Silty to Clayey windbreak suitability group.

Silty Alluvial Land

Silty alluvial land (0 to 31 percent slopes) (Sy) consists of frequently flooded bottom lands and deeply entrenched meandering channels of major drainageways. It formed in stratified, recently deposited alluvium that ranges from fine sandy loam to silty clay loam in texture, depending on the upland source.

The surface layer ranges from 20 to 32 inches in thickness, from very dark gray to dark brown in color, and from silt loam to loam in texture. The underlying material consists of stratified lenses of lighter colored silt loam to fine sandy loam material that has many reddish-brown mottles. This material lacks lime. Because of continuing deposits of alluvium, the profile has little development. The boundary to the underlying material is gradual and not easily recognized.

Most of the nearly level areas of this land type are frequently flooded and are not suitable for cultivation. Streambank cutting and channel changes commonly damage fences and field access roads. Most areas of this soil are used for grazing and as wildlife habitat. The dominant vegetation is tall and medium grasses with many trees and shrubs adjacent to the channels. Capability unit VIw-1, dryland; Silty Overflow range site; Moderately Wet windbreak suitability group.

Slickspots

Slickspots are mapped only in a complex with Butler and Hall soils on stream terraces of the major valleys. This land type is nearly level in most places but is gently sloping in a few areas. In cultivated areas Slickspots are light gray and are 1 to 5 acres in size.

The gray silt loam surface layer changes abruptly to subsoil at a depth of about 6 inches. The subsoil is dark-gray very firm silty clay in the upper part and grayish-brown firm silty clay loam that contains small salt crystals in the lower part. This layer is moderately alkaline to strongly alkaline. The underlying material is moderately alkaline light brownish-gray silt loam.

Slickspots are affected by moderate to high amounts of soluble salts and exchangeable sodium. Because of the slowly permeable subsoil and the deflocculated condition of the soil, the excessive soluble salts and sodium are difficult to leach below the root zone in the Butler-Slickspots complex. In the Hall-Slickspots complex the subsoil is slightly more permeable, but the exchangeable sodium causes restricted movement of water, air, and roots.

Slickspots are more droughty, and they release moisture less readily than the Butler or Hall soils with which they are in complex. They are sticky when wet and very hard when dry, and this causes a concern in tillage. The water table is at a depth of 5 to 15 feet depending on seasonal rainfall. The high pH value and the excessive amounts of sodium can cause a fixation and unavailability of many plant nutrients.

In areas of high salt or sodium accumulation, seed germination is poor, plants are stunted, and grain is of low quality. Using irrigation water of good quality, adequate drainage, proper chemical amendments, and organic matter can improve saline-alkali conditions. Slickspots are best suited to crops and grasses that are tolerant of excessive amounts of soluble salts and exchangeable sodium. Barley, Canada wildrye, and western wheatgrass are more tolerant than most crops and grasses (*4*).

Steinauer Series

The Steinauer series consists of deep, well-drained, moderately sloping to steep soils on uplands. These soils formed in limy glacial till material in the Oak Creek and Middle Creek drainage area.

In a representative profile the surface layer is grayish-brown clay loam about 6 inches thick (fig. 20). The next layer is light-gray clay loam which is hard when dry, firm when moist, and about 9 inches thick. The underlying till is light brownish-gray and light yellowish-brown clay loam. It is slightly weathered and has pockets and old root channels of white lime and many stains. Throughout the profile are few small pebbles and stones.

Permeability of the Steinauer soils is moderately slow. Available water capacity is high. Fertility is medium to low, and content of organic matter is moderate to low. If not protected, these soils erode easily.

Most of the steeply sloping Steinauer soils are in native grasses or are reseeded to pasture. Some moderately sloping soils are cultivated.

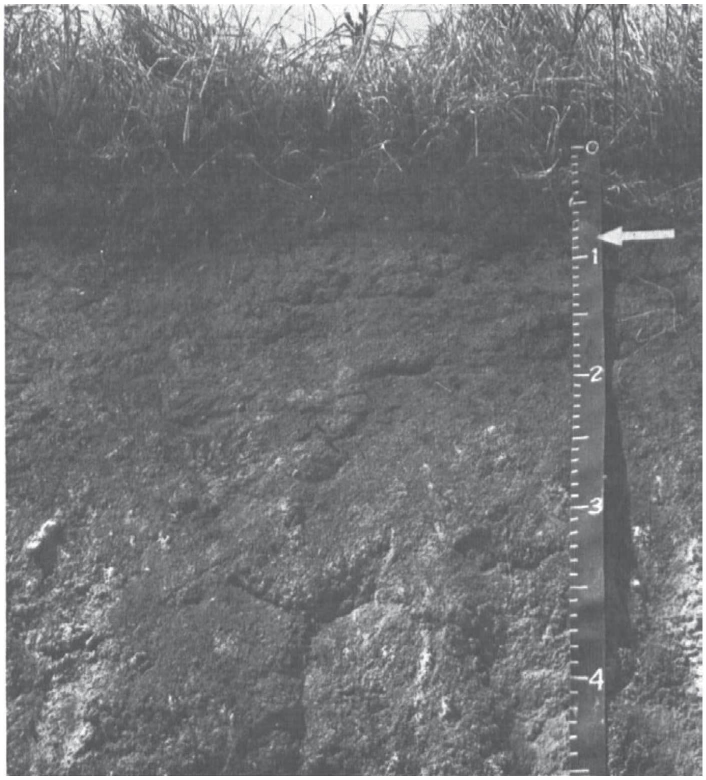

Figure 20.—**Profile of a Steinauer clay loam that has a thin surface layer and limy glacial till underlying material.**

Representative profile of Steinauer clay loam, 7 to 12 percent slopes, eroded (in reseeded pasture 0.2 mile south and 0.45 mile west of northeast corner of sec. 29, T. 11 N., R. 4 E.):

Ap—0 to 6 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure that parts to weak, medium, crumb; slightly hard when dry, friable when moist; few small pebbles and stones; mildly alkaline; abrupt, smooth boundary.

AC—6 to 15 inches, light-gray (10YR 6/1) clay loam, gray (10YR 5/1) when moist; weak, coarse and medium, subangular blocky structure; hard when dry, firm when moist; few small pebbles and stones; moderately alkaline; clear, smooth boundary.

C1—15 to 41 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; weak, coarse, prismatic structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; few small pebbles and stones; moderately alkaline; many, coarse, prominent, reddish-brown stains; many iron and manganese segregations and pockets of soft lime; diffuse, smooth boundary.

C2—41 to 60 inches, 60 percent light yellowish-brown (10YR 6/4) and 40 percent light brownish-gray (10YR 6/2) clay loam, yellowish brown (10YR 5/4) and grayish brown (10YR 5/2) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist; few small pebbles and stones; moderately alkaline; many iron and manganese segregations; pockets and seams of soft lime.

The A horizon ranges from 3 to 7 inches in thickness. It is very dark gray to brown in color and clay loam to loam in texture. Lime carbonates are at the surface to a depth of 15 inches. A few small boulders and stones are scattered on the surface. The C horizon of limy till has reddish-brown or yellowish-brown iron stains and relict mottles.

Steinauer soils are near the Burchard, Morrill, Pawnee, and Shelby soils. The profile of Steinauer soils is not so well formed as the Burchard and Shelby soils, and lime is closer to the surface. They have a less clayey B horizon than Pawnee soils, and lime has not been leached as deeply. Steinauer soils have less coarse material in their light yellowish-brown C horizon, which contains lime, than the Morrill soils.

Steinauer clay loam, 7 to 12 percent slopes, eroded (StC2).—This soil has the profile described as representative for the series. It is well drained and is in till on uplands. Erosion has removed much of the original surface soil. Included with this soil in mapping are small areas of Burchard soils.

Permeability of this soil is moderately slow. Available water capacity is high, and moisture is released readily to plants. Fertility is medium, and content of organic matter is moderately low. Runoff is rapid. In cultivated areas erosion is a hazard, and gullies form in some natural drainageways.

This soil is used for tame grass pastures and for close-growing crops of small grains and legumes. Improving and maintaining fertility is a major concern. Organic-matter content needs to be improved. Trees can be grown in windbreaks. Capability unit IVe–8, dryland; Limy Upland range site; Silty to Clayey windbreak suitability group.

Steinauer clay loam, 12 to 31 percent slopes (StE).—This soil is well drained and is on convex areas and very narrow ridgetops in glacial till on uplands.

The profile of this soil is similar to the one described for the series, except that it contains pockets and seams of lime within a depth of 10 inches. Small iron and manganese segregations and relic stains are more common in the underlying till. More pebbles and small stones are scattered throughout the profile and more large boulders are on the surface than described in the representative profile. Included with this soil in mapping are a few outcrops of volcanic ash which generally lack lime.

Because of the steep slopes and the moderately slow permeability, runoff is rapid. Plant roots can easily penetrate this soil, but fertility is medium to low and content of organic matter is moderately low. On overgrazed pastures the soil erodes and gullies form easily in natural drainageways. Most areas of this soil are in native grasses.

This soil is better suited to grazing and hay than to cultivated crops. It is too steep and the hazard of erosion is too great for successful cultivation. The main concern of management is improving the quality and quantity of the range. This soil can be used for trees in windbreaks. Capability unit VIe–9, dryland; Limy Upland range site; Silty to Clayey windbreak suitability group.

Steinauer clay loam, 12 to 31 percent slopes, eroded (StE2).—This well-drained soil occurs in till on the uplands of the Oak Creek and Middle Creek drainage area. Sheet erosion has removed most of the original surface soil.

The profile of this soil contains a thinner and lighter colored surface layer than that described as representative for the series. Cultivation has mixed the surface layer with the lighter colored underlying till. Lime is nearer the surface, and small stones and pebbles are more numerous on the surface of the soil. The underlying material contains slightly more reddish and yellowish-brown stains in the underlying material than that described as representative. Included with this soil in mapping are small areas of coarse sand and gravel.

Permeability of this soil is moderately slow. The abundance of lime, however, improves the structure and the roots penetrate the underlying till easily. Fertility and content of organic matter are low. The abundance of lime causes some deficiencies of minor nutrient elements.

In most areas this soil is reseeded to native grasses and tame pastures. Because of the steep slope, the severe hazard of erosion, and the limitations on the use of large machinery, this soil is better suited to permanent grasses than cultivated crops. Some small grains and alfalfa are grown. The main concern of management is maintaining the quality and quantity of the grass. Preventing water erosion and gullies is needed in most areas. Trees can be grown in windbreaks. Capability unit VIe-8, dryland; Limy Upland range site; Silty to Clayey windbreak suitability group.

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (Wx) consists of nearly level, medium-textured to fine-textured, very poorly drained soils on bottom lands. It is in areas that lack drainage outlets into the main channel of the stream. The water table is at the surface during wet periods and ranges to a depth of 24 inches during dry periods. Sand and gravel commonly crop out along the upland borders of these areas, and they have seepage which adds to their wetness.

The surface layer is very dark gray silty clay loam that is mildly alkaline. The subsurface layer is black and moderately alkaline. In pastured areas the surface is uneven clumps of grass. The underlying gleyed alluvial material is dark-gray silty clay that contains partly decomposed roots and stems of grasses. Reddish-brown stains and a few small lime concretions are throughout the profile. Included with this land type in mapping are a few small marshy areas.

Nearly all of the acreage of this land type is in native grasses, and these areas are better suited to grazing or hayland than to cultivated crops. Because the water table is at or near the surface during the growing season, these areas are not suitable for cultivation. A few areas, however, are drained and are used for cultivated crops. Wetness is the main hazard. Capability unit Vw-1, dryland; Wet Land range site; Very Wet windbreak suitability group.

Wymore Series

The Wymore series consists of deep, moderately well drained to well drained, nearly level to moderately sloping soils on uplands. These soils formed in a thin mantle of Peoria loess underlain by Loveland loess and till.

In a representative profile the surface layer is gray to dark-gray silty clay loam about 10 inches thick. The subsoil is about 29 inches thick. It is dark grayish-brown silty clay loam in the upper 3 inches, dark grayish-brown to grayish-brown silty clay in the next 14 inches, and is light brownish-gray silty clay loam in 12 inches. The underlying material is moderately alkaline light-gray silt loam that contains a few small, reddish-brown iron stains.

Permeability of these soils is slow. Available water capacity is high, and fertility is medium to high. The hazard of water erosion is serious in sloping areas if row crops are grown.

Most areas of Wymore soils are cultivated, but some areas are in introduced grasses and are used for pasture.

Representative profile of Wymore silty clay loam, 0 to 1 percent slopes (in a cultivated field 0.25 mile south and 0.45 mile east of the northwest corner of sec. 22, T. 9 N., R. 4 E.):

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

A12—5 to 10 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; slightly hard when dry, friable when moist; slightly acid; clear, smooth boundary.

B1—10 to 13 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, blocky structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; clear, smooth boundary.

B21t—13 to 21 inches, dark grayish-brown (10YR 4/2) silty clay, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure that parts to moderate, medium, blocky; very hard when dry, very firm when moist; neutral; clay films on ped faces; clear, smooth boundary.

B22t—21 to 27 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure that parts to moderate, coarse, blocky; very hard when dry, very firm when moist; neutral; clay films on ped faces; clear, smooth boundary.

B23—27 to 33 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, subangular blocky structure that parts to moderate, medium, subangular blocky; hard when dry, firm when moist; neutral; gradual, smooth boundary.

B3—33 to 39 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; weak, medium and fine, subangular blocky structure; hard when dry, firm when moist; mildly alkaline; calcareous; common, fine, faint, yellowish-brown stains; a few small iron and manganese segregations; gradual, smooth boundary.

C—39 to 60 inches, light-gray (5Y 7/2) silt loam, pale olive (5Y 6/3) when moist; massive; slightly hard when dry, friable when moist; moderately alkaline; calcareous; a few small iron and manganese segregations.

The A horizon ranges from 5 to 12 inches in thickness. It ranges from light silty clay loam in nearly level areas to silty clay in severely eroded areas that are moderately sloping. The color ranges from gray to very dark grayish brown, and the reaction from mildly acid to neutral. The B2t horizon ranges from light silty clay to heavy silty clay in texture. The C horizon ranges from silt loam to silty clay loam in texture and from grayish brown to olive gray in color. Depth to lime ranges from about 60 inches in nearly level areas to about 12 inches in moderately sloping areas. The loess mantle is 3 to 10 feet thick over fine-textured till.

Slickspots less than 1 acre in size are common in areas where the loess and till meet. The fine-textured till restricts downward movement of water. As a result, the water moves laterally along the surface of the till and seeps out on the lower slopes. The seep water contains sodium salts that accumulate and cause a saline-alkaline condition.

Wymore soils are near the Burchard, Longford, Pawnee, and Sharpsburg soils. They lack the sand and stones that are in the Burchard and Pawnee soils, but they have a more strongly developed profile than those soils. Unlike Longford soils Wymore soils formed in Peoria loess. Wymore soils have a more clayey B horizon than Sharpsburg soils, and they formed in a thinner mantle of Peoria loess than Sharpsburg soils.

Wymore silty clay loam, 0 to 1 percent slopes (Wt).—This soil has the profile described as representative for the series. It is moderately well drained and occurs on uplands. Most areas are on the divide between the Big Blue River and the area drained by Oak Creek and Middle Creek. Included with this soil in mapping are small areas of a somewhat poorly drained soil in depressions.

This soil is more droughty than a less clayey soil because it absorbs water more slowly and releases it slowly to plants. Runoff is slow. Fertility is high and content of organic matter is moderate.

Most of the acreage of this soil is cultivated, and the major crops are grain sorghum and wheat. Small acreages are in corn and alfalfa. Trees can be grown in windbreaks.

Lime is needed for newly seeded alfalfa and other legumes, and available phosphorus is low. The main concerns of management in irrigated areas are maintaining fertility and managing water. Capability units IIs–2, dryland, and IIs–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Wymore silty clay loam, 1 to 3 percent slopes (WtA).—This well-drained soil is on the upland divide between the Big Blue River and the area drained by Oak Creek and Middle Creek. Runoff is medium.

Except that the surface layer and subsoil are slightly thinner, this soil has a profile similar to that described as representative for the series. Included in mapping are a few small areas of Butler soils.

Moisture is released slowly to plants, and this soil is slightly droughty during dry seasons. Permeability is slow. Fertility and content of organic matter are moderate.

Grain sorghum and wheat are the major crops grown on this soil, though on a small acreage alfalfa and corn are grown. Trees can be grown in windbreaks. Lime is needed for legumes, and the supply of phosphorus is low. In irrigated areas the major concern of management is maintaining fertility. Capability units IIe–2, dryland, and IIe–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Wymore silty clay loam, 3 to 7 percent slopes, eroded (WtB2).—This well-drained soil is on uplands. It has a thinner surface layer and subsoil than in the profile described as representative for the Wymore series and has more reddish-brown stains and more olive-gray colors in the upper part of the subsoil. Also, it contains more lime and is less acid. Included in mapping are small severely eroded areas.

Runoff is medium on this soil. Available water capacity is high, but moisture is released slowly to crops. Areas that are clean tilled have a further hazard of erosion. Fertility is medium, and content of organic matter is moderate.

Grain sorghum and wheat are the main crops grown on this soil, but alfalfa and corn are grown in small areas. Trees can be grown in windbreaks. The supply of lime is adequate for most legumes. Available phosphorus is low. The main concerns of management are controlling erosion, maintaining fertility, and controlling soil blowing. Capability units IIIe–2, dryland, and IIIe–2, irrigated; Clayey range site; Silty to Clayey windbreak suitability group.

Wymore soils, 7 to 9 percent slopes, eroded (WyC2).—This well-drained soil is on uplands. The areas are cut by many small rills and gullies.

The surface layer of this soil is finer textured than that in the profile described as representative for the Wymore series and the subsoil is thinner. Also, lime is closer to the surface and iron stains are more common. Plowing has mixed lighter colored material formerly in the subsoil with the remaining surface layer. Included with this soil in mapping are small areas of Slickspots near the area where the loess and the till meet.

Runoff is rapid on these soils. Permeability is slow. The clayey subsoil absorbs moisture slowly and releases it slowly to plants. Tillage is difficult because the surface layer is sticky when wet and very hard when dry. Fertility is medium, and content of organic matter is moderately low.

The many rills and gullies in these soils make them better suited to permanent vegetation than to tilled crops. A few areas are cultivated as part of larger acreages of more friable soils. These soils are droughty; and where farmed, erosion is the main hazard. Available phosphorus is low. Capability unit IVe–2, dryland; Dense Clay range site; Silty to Clayey windbreak suitability group.

Use and Management of the Soils

This section explains the capability grouping used by the Soil Conservation Service and the basic practices of management that apply to all of the soils. Next, management of the soils by dryland and irrigated capability units is described, and estimated average acre yields of the principal crops are given. Then, management of the soils for range, for windbreaks, and for wildlife and recreation is described.

Management of the Soils for Crops [2]

In this section the capability system used to classify soils used for the production of cultivated crops and pasture is explained, and management of the soils in the county, by capability units, is discussed. Then, a table showing estimated yields of the principal crops is given.

If the soils in Seward County are properly managed, they are suited to crops and pasture. The chief concerns of management are controlling erosion caused by rain falling on sloping soils on uplands, protecting some of the soils adjacent to streams from flooding, and avoiding loss of fertility because of removal of the surface layer.

According to the Nebraska Agricultural Statistics report, in 1969 about 80 percent of the acreage of Seward County was cultivated. About 16 percent of the cultivated areas, or slightly less than 58,000 acres, was irrigated.

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

Corn is the main irrigated crop. Winter wheat, sorghum, and corn are the main dryland crops. Other crops grown in Seward County are soybeans and alfalfa and grasses for pasture and hay. Small acreages of oats, barley, and rye are also grown. Idle areas include summer fallow and diverted acreages under the government crop-control program.

Practices that help to control erosion are the use of terracing, contour farming, land leveling, contour bench leveling, and grassed waterways. These practices can be used along with proper management of vegetation on the surface of the areas. Keeping crop residue on the surface or growing a protective cover of plants helps to prevent the soil from sealing or crusting during heavy rains. Tall stubble that is left standing throughout winter can catch drifting snow and help to replenish soil moisture.

Erosion can also be reduced by managing an adequate cropping system. A suitable system for row crops uses soils that support crops well and that have little or no hazard of erosion and uses the steeper, eroded soils for hay and pasture.

Soil blowing can be reduced by using the same practices that conserve soil moisture. Using stubble mulching on small grains, mulch planting for row crops, and alternate narrow strips of row crops and small grains help reduce wind velocity on the soil surface and thus reduce the movement of soil particles by soil blowing.

Managing tillage properly in preparing the seedbed and leaving all crop residue on the surface are ways of improving the soil, reducing soil losses, and lessening compaction of the soils.

Commercial fertilizer should be applied according to the needs of the soils, as indicated by soil tests. The amount of moisture in the soil should also be considered, especially in dryland areas. For example, during a period of low rainfall less fertilizer is needed on soils that have a dry subsoil than in a year when the supply of moisture is adequate. Crops on all of the soils respond if nitrogen fertilizer is applied. Phosphorus and zinc generally are needed on eroded soils on uplands, such as those of the Hastings, Geary, and Sharpsburg series. Because of the chance of a greater crop growth, soils that are irrigated need larger amounts of fertilizer than those not irrigated.

If the gravity irrigation systems are to be used, those soils to be irrigated need leveling. Leveling allows even water distribution and better control of runoff. All soils in the county are suitable for sprinkler irrigation, but only the deep, level to gently sloping soils are suitable for furrow and border gravity irrigation systems. Soils that are on slopes of more than 8 percent are not suitable for satisfactory irrigation. A system is needed that controls and manages irrigation runoff from sloping fields.

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 rice, cranberries, horticultural crops, or 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 for 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.

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

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, windbreaks, 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 IVw-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Seward County are described, and suggestions for the use and management of the soils are given.

CAPABILITY UNIT I-1, DRYLAND; I-1, IRRIGATED

Soils in these capability units are deep, well-drained, and nearly level. They are on uplands, stream terraces, and bottom lands. These soils have a surface layer and subsoil of silt loam or silty clay loam.

The soils in these units absorb water well and release moisture readily to plants. Permeability is moderate to moderately slow, and available water capacity is high. The content of organic matter is moderate, and these soils are fertile.

The main concerns of management are maintaining the content of organic matter and keeping fertility high. The soils can be farmed intensively without risk of damage.

Dryland management.—Dryfarmed areas of these soils are suited to corn, sorghum, wheat, soybeans, and alfalfa. They are also suitable for tame grass, for trees grown in windbreaks, and for wildlife habitat.

Crops grow well on these soils if a cropping system is used that includes proper management of crop residue. Adequate amounts of fertilizer also are needed. Diseases and insects can be controlled by using a cropping system that alternates row crops with small grains and hay and pasture.

Irrigation management.—Irrigated areas of these soils are suited to corn, sorghum, alfalfa, and tame grasses for hay and pasture.

These soils are well suited to irrigation, and most kinds of irrigation systems are suitable. Unless the soils are leveled, however, slight irregularities in the surface make it difficult to apply irrigation water uniformly (fig. 21). The water should be applied in sufficient amounts to serve the needs of the crop and at a rate that permits maximum absorption and minimum runoff. Any irrigation water that runs off at the end of a field can be trapped in a pit and recycled. Leaving crop residue on the soil in winter helps to control soil blowing. Soils altered by leveling are likely to require applications of iron and zinc.

CAPABILITY UNIT IIe-1, DRYLAND; IIe-1, IRRIGATED

Soils in these capability units are deep, well drained, and very gently sloping. These soils are on uplands, stream terraces, and occasionally flooded bottom lands.

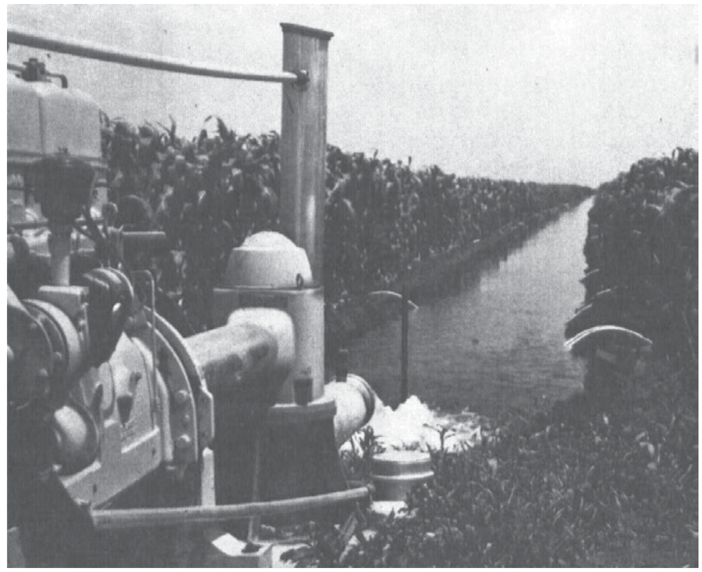

***Figure 21.*—Irrigation from a deep well using a siphon tube system on soil that has been leveled. The soil is in capability unit I-1.**

They have a silt loam to silty clay loam surface layer and subsoil.

The soils in these units absorb water well and release moisture readily to plants. Permeability is moderately slow to moderate. Available water capacity is high. Most of these soils have high fertility and they are easy to till. Content of organic matter is moderate or moderately low.

The main concern of management on these soils is controlling runoff. If runoff is controlled the moisture supply of the soil can also be maintained. Maintaining good tilth, high fertility, and content of organic matter are also needed.

Dryland management.—Dryfarmed areas of these soils are suited to corn, wheat, sorghum, soybeans, alfalfa, and pasture grasses. The main crops are corn and sorghum. On the upland soils wheat is well suited because the crop can mature before the warm, drier periods of the crop season. Terracing, contour farming, and grassed waterways are needed to control runoff. A cropping system that includes a vegetative cover crop most of the time helps to reduce the loss of moisture in these soils.

Irrigation management.—Irrigated areas of these soils are suited to corn, sorghum, and alfalfa. If these soils are gravity irrigated, land leveling is needed to provide an even distribution of water and to prevent excessive leaching of fertilizer. Contour furrows, bench leveling, and terracing help reduce the slope, provide an even distribution of water, and control erosion. Leaving crop residue on the soils helps to increase the water intake and to control soil blowing. Irrigation water that runs off at the end of a field can be trapped and recycled.

CAPABILITY UNIT IIe-2, DRYLAND; IIe-2, IRRIGATED

Soils in these capability units are deep, well drained to moderately well drained, and very gently sloping. These soils are on uplands and stream terraces. They have a surface layer of silt loam to silty clay loam and a subsoil of silty clay.

Available water capacity is high, and the slowly permeable subsoil restricts penetration of roots and water. Runoff on these soils is medium. The content of organic matter is moderate and fertility is high. The main concerns of management on these soils are controlling runoff and maintaining high fertility and good tilth.

Dryland management.—Dryfarmed areas of these soils are suited to crops commonly grown in the county, but corn, wheat, sorghum, soybeans, and alfalfa are the main crops grown. Because of the slow release of soil moisture, these soils are better suited to crops that mature early in summer, such as wheat and first-cutting alfalfa, than to other crops. Contour farming, terracing, and grassed waterways are needed to control runoff. Keeping tillage to a minimum allows the maximum crop residue to remain on the soil surface for use as a mulch. Row crops can be alternated with small grains and legume crops.

Irrigation management.—Irrigated areas of these soils are well suited to corn, sorghum, small grains, soybeans, and alfalfa. They are also suitable for growth of pasture grasses and hay, for windbreaks, and for use as wildlife habitat. Growing small grains and legumes in the cropping system and using mulch tillage, which leaves crop residue on the surface, helps replenish the content of organic matter.

If these soils are leveled, furrow and border irrigation are suited. The layout of the irrigation field and the water application rates need to be adjusted on these soils to allow for a slower rate of water intake. Sprinkler irrigation is suited in areas where land leveling is costly. Irrigation runoff at the ends of fields needs to be controlled and reduced to conserve irrigation water.

CAPABILITY UNIT IIs-2, DRYLAND; IIs-2, IRRIGATED

Soils in this capability unit are deep and nearly level on uplands. They are moderately well drained. They have a surface layer of silt loam to silty clay loam and a subsoil of silty clay.

These fertile soils retain moisture and nutrients well but absorb and release water slowly to plants. Permeability of these soils is slow. Available water capacity is high, and runoff is slow.

The major hazard on these soils is a somewhat droughty condition that exists in seasons of low rainfall.

Dryland management.—Dryfarmed areas of these soils are suited to most crops commonly grown in the county and to trees and grasses. Suitable crops are corn, sorghum, small grains, alfalfa, and grasses. Because these soils release moisture slowly from the subsoil, they are well suited to wheat and grain sorghum. A cropping system that includes good tillage management and the alternating of row crops with small grains and legumes helps to increase the moisture intake rate of these soils.

Irrigation management.—Irrigated areas of these soils are mainly suited to corn, sorghum, and alfalfa. Both border and furrow irrigation systems are suitable. More frequent and lighter irrigations are needed on these soils, especially when corn is the main crop. A good cropping system is one in which a legume or grass crop is grown every 10 or 15 years and is then left on the soil for two or more years. The roots of legumes help to increase the moisture intake and permeability of the soil. Reducing and controlling irrigation runoff at the ends of the fields is also needed to conserve water. For a sustained crop growth on these soils, extensive use of commercial fertilizers and barnyard manure is needed.

CAPABILITY UNIT IIw-2, DRYLAND; IIw-2, IRRIGATED

Soils in these capability units are deep, somewhat poorly drained, and nearly level. They are on uplands and stream terraces. These soils have a surface layer of silt loam. The subsoil is clay in the upper part, silty clay in the middle part, and silty clay loam in the lower part. The underlying material is silt loam.

Available water capacity is high. Permeability is slow in the subsoil; movement of moisture, roots, and air is restricted; and moisture is released slowly to plants. Runoff is slow. The content of organic matter is moderate.

The main concern of management is reducing wetness. In spring, when rainfall is heaviest, these soils dry slowly and tillage is generally delayed. However, the soils are droughty during the hottest part of the summer under dryland management.

Dryland management.—Dryfarmed areas of these soils are suited to small grains, corn, and grain sorghum; and alfalfa, wheat, and grain sorghum are better suited. A cropping system that includes 3 or 4 years of row crops alternating with small grains and alfalfa helps to create a more permeable subsoil condition. Terraces and diversions on the adjacent soils that drain into this soil area help to reduce excessive wetness.

Irrigation management.—Irrigated areas of these soils are suited to corn, grain sorghum, and alfalfa. Including alfalfa in the cropping system every 6 to 10 years helps to increase the movement of water through the soil. Because permeability is slow in this soil, longer irrigation sets are needed. Measures to control flooding from adjacent areas are needed in some places. Land leveling permits an even distribution of water from gravity irrigation systems. Practices to control excess irrigation water are generally needed on soils in this capability unit.

CAPABILITY UNIT IIw-3, DRYLAND; IIw-3, IRRIGATED

Hobbs silt loam, occasionally flooded, is the only soil in these units. It is deep, nearly level, and on bottom lands that are occasionally flooded for short periods. It is moderately well drained. It has a surface layer and subsoil of silt loam.

Permeability of this soil is moderate, and available water capacity is high. This soil is easy to till, and fertility is high. It retains water and nutrients well and releases them readily to plants. Crops are occasionally damaged by floods and deposits of sediment. Floodwaters recede rapidly. During dry periods the excess water benefits the crops.

The main concern of management on this soil is controlling occasional flooding. Planting and cultivating are commonly delayed because the soil is too wet.

Dryland management.—Dryfarmed areas of this soil are suited to corn, sorghum, small grains, and alfalfa. Occasional flooding limits growth of small grains and alfalfa. This soil is also suitable for tame grasses and trees and for use as wildlife habitat.

Diversions and drainage ditches are needed in most areas to intercept runoff and to keep it from spreading over a wide area. Drainage ditches and diversions need to be kept clean to intercept floodwaters. Suitable outlets are needed for drainage ditches.

Irrigation management.—Irrigated areas of this soil are well suited to corn and sorghum. If flooding is controlled, they are also suited to alfalfa and small grains.

Land leveling and installing an irrigation system that provides for the diversion or interception of floodwaters are needed. Sprinkler irrigation is suited to these soils, but furrow and border irrigation are better suited. Management is also needed that reduces or controls irrigation water at the ends of the fields.

Adequate commercial fertilizer and mulch tillage are needed to protect the soil during the growing of irrigated crops. Commercial fertilizer and barnyard manure are needed for good crop growth.

CAPABILITY UNIT IIw-4, DRYLAND; IIw-4, IRRIGATED

Only Lamo silty clay loam is in these capability units. This soil is deep and somewhat poorly drained. It is on bottom lands. Both the surface layer and the subsoil are silty clay loam.

The level of ground water fluctuates between a depth of 2 and 6 feet. Permeability is moderately slow. Available water capacity is high. Content of organic matter is moderate, but the soil dries slowly in the spring. Planting of row crops can be delayed because of wetness. During wet periods the water table is high enough to limit crop growth, but during dry periods crops are helped by the water table.

The main concern of management on this soil is controlling wetness during periods of above average rainfall. Salts accumulate on the surface in places during spring months.

Dryland management.—Dryfarmed areas of this soil are better suited to corn and sorghum than to other crops. Because of the high ground water level in the spring, small grains and alfalfa are not so well suited. Wetness generally prevents tillage and cultivation early in spring. Diversions, drainage ditches, or tile drains help control wetness and the high water table. Trees grow well in windbreaks.

Irrigation management.—Irrigated areas of this soil are suited to corn, sorghum, and alfalfa. Drainage ditches, tile drains, and diversions help to lower the water table. Amounts of fertilizer needed are greater when the soil is irrigated than when the soil is dryfarmed.

Land leveling is needed if furrow and border irrigation are used. Land leveling also helps provide surface drainage. Crop residue can be worked into the soil by mulch tillage or left on the surface to protect the soil.

CAPABILITY UNIT IIIe-1, DRYLAND; IVe-1, IRRIGATED

Soils in these capability units are deep, well drained, and moderately sloping. These soils are on till and loess uplands. They have a surface layer and a subsoil of clay loam or silty clay loam.

Permeability is moderately slow in these soils. Fertility is medium to high and the content of organic matter is moderate. Available water capacity is high, and moisture is released readily to plants. Runoff is rapid.

The main concern of management is controlling water erosion. These soils are more susceptible to erosion than most other moderately sloping soils.

Dryland management.—Dryfarmed areas of these soils are better suited to corn, sorghum, small grains, and alfalfa and grasses than to other crops. Some crops are likely to be damaged in summer because runoff is rapid on these soils.

A cropping system that limits the years of consecutive row crops and that includes such close-growing crops as small grains, alfalfa, and grasses helps to control erosion and to conserve water. Terraces, contour farming, grassed waterways, and the use of crop residue as a mulch help to reduce runoff and control erosion (fig. 22).

Irrigation management.—Irrigated areas of these soils are better suited to alfalfa and grasses than to other crops. Corn, sorghum, and other row crops are suited if erosion is controlled. Terraces, grassed waterways, and crop residues on the soil help to control erosion. Commercial fertilizer and barnyard manure are needed to maintain and improve fertility.

Sprinkler irrigation is suited to these soils. Soils having slopes of more than 8 percent are not suited to irrigation. The slope of these soils makes it difficult to control erosion under natural rainfall and the additional irrigation applications. The rates of water application need to be carefully controlled so as not to exceed the intake rate of these soils.

CAPABILITY UNIT IIIe-2, DRYLAND; IIIe-2, IRRIGATED

Soils in these capability units are deep, moderately well drained, and gently sloping. They are on till and loess uplands. These soils have a surface layer of silty clay loam to clay loam and a subsoil of silty clay loam to clay.

Permeability is slow in these soils. Available water capacity is high, but moisture is not readily released to plants. Runoff is medium. The content of organic matter is moderate; fertility is medium. The main concern of management is controlling water erosion.

Dryland management.—Dryfarmed areas of these soils are best suited to grain sorghum and winter wheat. Corn, soybeans, spring small grains, alfalfa, and grasses are also suited to these soils. These soils can also be used for permanent hay, pasture, and windbreaks and as wildlife habitat.

A cropping system that limits row crops to not more than 2 years and that includes deep-rooted legume crops helps to improve fertility and tilth. Using commercial fertilizers and barnyard manure and returning crop residue to the soil help to maintain the content of organic matter and to improve fertility.

If row crops are grown, terraces and contour tillage (fig. 23) are needed to help to control erosion. Grassed waterways and field borders help to control erosion.

Irrigation management.—Irrigated areas of these soils are better suited to corn and sorghum than to other crops. Land leveling and contour bench leveling are needed to help control erosion and to conserve water. If furrow and border irrigation systems are used, they need to be designed so that the slope of crop rows and the direction of irrigation are not more than 1 percent.

The sprinkler method of irrigation is suitable on these soils. The water should be applied at a very low rate. Practices are needed that control and reduce the amount of irrigation water that runs off at the end of a field.

Figure 22.—Complete conservation treatment and a cropping system that includes hayland help to control erosion on this Burchard soil. This soil is in capability unit IIIe-1, dryland.

Figure 23.—Crops planted on the contour on terraced soils of the Pawnee series. Capability unit IIIe-2, dryland.

CAPABILITY UNIT IIIe-8, DRYLAND; IIe-11, IRRIGATED

Only Hastings soils, 1 to 3 percent slopes, severely eroded, are in these capability units. These soils are deep and well drained and are on uplands. They have a silt loam or silty clay loam surface layer and a silty clay loam subsoil. Most of the original surface layer and subsoil were removed and used as subbase fill in highway construction.

These soils are difficult to till because the surface layer is sticky when wet and hard when dry. Permeability is moderately slow, and available water capacity is high. Fertility and content of organic matter are low.

The main concerns of management on these soils are restoring and maintaining the content of organic matter and keeping fertility high. Control of runoff is also needed.

Dryland management.—Soils in areas that are dry-farmed are suited to corn, sorghum, small grains, grasses, and alfalfa. They are also suitable for tame grasses and for trees grown in shelterbelts.

The content of organic matter in these soils can be increased if a cropping system is used that includes the frequent growing of grasses and legumes. It can also be increased by returning all crop residue to the soil. Using commercial fertilizer and barnyard manure helps to maintain and improve fertility. The barnyard manure adds both organic matter and plant nutrients to the soil. Runoff can be controlled and moisture conserved by using terraces and grassed waterways, by farming on the contour, and by leaving crop residue on the surface.

Irrigation management.—Irrigated areas of the soils in this capability unit are suited to corn, sorghum, small grains and grasses, and alfalfa. Growing crops that produce a large amount of residue helps to maintain the content of organic matter. Commercial fertilizer and barnyard manure are needed to keep fertility high and to obtain good crop growth. Reducing and controlling the amount of water that runs off at the end of a field help to conserve water. Furrow and border irrigation can be used if erosion is controlled by contour bench leveling or by terracing and farming on the contour.

CAPABILITY UNIT IIIe-11, DRYLAND; IIIe-1, IRRIGATED

Soils in these capability units are deep, well drained and moderately well drained, and sloping to moderately sloping. These soils are on uplands and stream terraces. They have a surface layer and subsoil of silt loam or silty clay loam.

Permeability of these soils is moderate to moderately slow. Available water capacity is high. Runoff is medium to rapid. If not protected, these soils erode easily. Fertility is medium to high, and these soils are easily tilled. If properly managed they retain water and nutrients well and release moisture readily to plants.

The main concern of management of the soils is controlling water erosion. Other concerns are conserving moisture and maintaining good tilth, high fertility, and content of organic matter.

Dryland management.—Dryfarmed areas of these soils are suited to corn, sorghum, small grains, and alfalfa. Tame grasses and trees in windbreaks are also suited.

A cropping system is needed that includes more close-growing crops, such as small grains, alfalfa, grasses, and row crops. Row crops grow well in fields that are terraced and contour farmed, but these crops need to be limited to 2 or 3 consecutive years. The best cropping system is one that includes a legume and grass crop grown every 8 to 12 years and allowed to remain on the soil for 2 or more years.

Lime and fertilizer are needed. Weeds and erosion can be controlled by using grassed borders along roadways and turnrows at the end of the fields. Terraces, grassed waterways, contour farming, and use of crop residue as mulch help to control runoff and erosion.

Irrigation management.—Irrigated areas of these soils are better suited to alfalfa and grasses than to other crops. Corn and sorghum, however, are suited if erosion is controlled. Terraces, contour irrigation, waterways, and use of the maximum amount of crop residue on the surface help to control erosion. Fertility can be maintained and improved by using manure and commercial fertilizer.

Sprinkler irrigation is preferred for these soils. Furrow and border irrigation methods can be used if land leveling operations are extensive enough to adjust slopes to a point where water erosion and runoff can be kept to a minimum. The slope of these soils, however, makes it difficult to control erosion under natural rainfall and the additional irrigation applications. The rates of water application need to be carefully controlled so as not to be at a rate higher than the intake rate of the soils. Contour bench leveling can be used on most gentle slopes of these soils.

CAPABILITY UNIT IIIe-81, DRYLAND; IIIe-11, IRRIGATED

Soils in these capability units are deep, well drained, and gently sloping. These severely eroded soils are on uplands. They have a surface layer and subsoil of silty clay loam.

Permeability is moderately slow. Available water capacity of the soils in this unit is high, and the soils release moisture readily to plants. Content of organic matter is low. Erosion has removed most of the surface soil and, in places, part of the subsoil. Fertility of the soils, therefore, is low. Runoff is medium.

The main concerns of management are controlling erosion and increasing fertility and organic matter.

Dryland management.—Dryfarmed areas of these soils are suited to corn, sorghum, small grains, alfalfa, and grasses; but such close-growing crops as wheat, alfalfa, and grasses are better suited. Trees can be grown in windbreaks. Row crops should not be grown for more than 1 or 2 consecutive years. Terraces, contour farming, grassed waterways, seeded field borders, and returning crop residue to the soil help to control erosion. Gullied areas can be smoothed or shaped before they are used for crops.

Large amounts of fertilizer are needed to produce large amounts of crop residue. Keeping tillage to a minimum helps to keep the mulch on the soil surface.

Irrigated management.—Irrigated areas of these soils are better suited to alfalfa and grasses than to cultivated crops, but corn and sorghum are suited if erosion is controlled. Terraces, contour irrigation, grassed waterways, and returning all crop residue to the soil help to control erosion. Using manure and commercial fertilizer helps to maintain and improve fertility.

Sprinkler irrigation is suited to these soils. Furrow and border irrigation is suited if slopes have been leveled sufficiently to keep erosion and runoff to a minimum. Because of the slopes, the control of erosion is difficult on these soils when excessively irrigated and during rains. Rates of water application need to be carefully controlled and applied at a lower rate than the intake rate of the soil. Management is also needed that reduces or controls runoff of irrigation water at the end of the field.

CAPABILITY UNIT IIIe-82, DRYLAND; IVe-11, IRRIGATED

Sharpsburg silty clay loam, 7 to 12 percent slopes, severely eroded, is the only soil in these capability units. It is well drained and on uplands. This soil has a surface layer and subsoil of silty clay loam. Most of the surface layer has been removed by water erosion.

Permeability of this soil is moderately slow. Runoff is rapid. Available water capacity is high. Fertility and the content of organic matter are low.

The main concern of management is controlling erosion. Other concerns are increasing and maintaining high fertility and content of organic matter.

Dryland management.—Dryfarmed areas of this soil are better suited to such close-growing crops as winter wheat, alfalfa, and grasses than to other crops. It is also suited to limited use of row crops, such as corn and sorghum, and to pasture, range, woodland, and as wildlife habitat. Trees can be grown in windbreaks.

A cropping system is needed that provides the maximum amount of crop residue for use as mulch on the surface. Either commercial fertilizer or barnyard manure is needed to increase and maintain soil fertility.

Irrigation management.—Irrigated areas of this soil are suited to hay crops, such as alfalfa and grasses. The soils in this unit are also suited to irrigated pasture if the slopes are not more than 8 percent. Sprinkler irrigation is preferred. Because of the erosion hazard, irrigating on slopes of more than 8 percent is not advisable. Rates of water application need to be controlled to prevent excessive runoff and erosion.

CAPABLITY UNIT IIIs-1, DRYLAND; IIIs-1, IRRIGATED

Soils in these capability units are nearly level to very gently sloping on stream terraces. They have a surface layer of silt loam to silty clay loam and a subsoil of silty clay loam to silty clay. These soils are somewhat poorly drained.

Slickspot areas in these soils take in water slowly, but the surface layer remains wet and sticky after rainfalls. When the soil dries it becomes very hard and contains prominent surface cracks. The amount of salts and alkali in these soils is not uniform, but the highest concentration is in the areas of the Slickspots. These Slickspot areas range from 1 to 3 acres in size and are 50 to 200 feet apart. Permeability of these soils is slow. Because of the effect of the alkali, the available water capacity is low or moderate.

The main concern of management is controlling alkalinity and salinity. Some plant nutrients are not available. Spring tillage is often delayed because of wetness.

Dryland management.—Dryfarmed areas of these soils are better suited to grasses that tolerate alkali; but where the alkali is controlled, such small grains as sorghum and alfalfa are also suited. Corn is not well suited because it does not tolerate the saline-alkali condition. Certain kinds of trees can be grown in shelterbelts.

If suitable outlets are available, the water table can be lowered by drainage, and these soils can be partially reclaimed by adding amendments to correct the alkalinity and by leaching the soluble salts to a depth below the rooting zone. Large additions of organic matter help diminish the effect of the alkali salts on the crop. The supply of organic matter and plant nutrients can be increased by using manure, fertilizer, and legumes in the cropping system.

Irrigation management.—Irrigated areas of these soils are suited to sorghum, wheat, barley, and grasses that tolerate alkali. They are also suited to corn, oats, soybeans, and alfalfa. Using adequate drainage systems lowers the water table. Suitable outlets are needed to install drainage systems. Irrigating adds to the leaching action and helps the reclamation of these soils. Adding barnyard manure, crop residue, or green-manure crops to these soils helps improve tilth. Farm animals and machinery can compact the soil during wet seasons. Leaving a cover of crop residue on these soils helps prevent crusting after rains. It also helps improve and reclaim these soils.

Sprinklers are suited to these soils. Furrow and border irrigation is also suited in areas where land leveling and drainage are provided. Rates of water application need to be controlled and adjusted to correspond to the rate of soil intake.

CAPABILITY UNIT IIIw-2, DRYLAND; IIs-21, IRRIGATED

Only Fillmore silt loam is in these capability units. This soil is deep, nearly level, and poorly drained and is in shallow depressions on uplands. It is occasionally flooded during seasons when rainfall is above average. The surface layer is silt loam, and the subsoil is dense silty clay.

Permeability is slow in this soil. Available water capacity is high. If no drainage outlets are available, surface water collects and remains in the depressions until it is absorbed or evaporated. The subsoil absorbs and releases water slowly, and penetration of air and roots is restricted, especially after the moisture supply reaches the wilting point.

The main concern of management is controlling flooding. Unless suitable outlets are available, surface drainage systems to remove excess water are difficult to install.

Dryland management.—Dryfarmed areas of this soil are suited to corn, sorghum, small grains, and grasses; but they are better suited to sorghum and small grains than to corn. Alfalfa is not well suited because of the hazard of drowning. Trees can be grown in windbreaks, and tame grasses can be grown in pastures.

The accumulation of runoff in the lower lying depressions can be controlled by constructing terraces and diversions on surrounding higher soils. If outlets are available much of the excess water can be removed by using open ditches.

Irrigation management.—Irrigated areas of this soil are suited to corn, sorghum, and tame grasses. A cropping system that includes shallow-rooted legumes or legume-grass mixtures every 4 or 5 years helps to maintain fertility and tilth. It also helps to improve the capacity of the soil to absorb water. Managing crop residue and returning the residue to the soil help to increase the supply of organic matter.

Furrow and border irrigation are suitable for this soil. Only a small amount of land leveling is needed to prepare the soil for these types of irrigation. Land leveling is needed for surface drainage; and where outlets are available, drainage ditches or tile drains can be installed to remove excess water.

Sprinkler irrigation is also suited. The rates of water application need to be adjusted so as not to exceed the intake rate of the soil. Using commercial fertilizer or barnyard manure in adequate amounts helps to maintain fertility and to promote good growth of crops.

CAPABILITY UNIT IVe-1, DRYLAND; IVe-12, IRRIGATED

In these capability units are well-drained, moderately sloping soils on uplands. These soils have a silty clay loam surface layer and subsoil.

Permeability is moderately slow in these soils. Available water capacity is high, and moisture is readily released to plants. Runoff is rapid. Fertility is moderate to low. The hazard of erosion is severe.

Steepness of slope limits the use of large farm machinery. These soils are moderately eroded, and controlling erosion is the main concern of management. Increasing and maintaining fertility and the content of organic matter are also concerns.

Dryland management.—Dryfarmed areas of these soils are suited to wheat, corn, sorghum, grasses, and legumes. They are also suited to pasture, rangeland, windbreaks, and wildlife areas. Keeping the areas in grasses and legumes most of the time helps to control erosion. Row crops can be limited to about 1 year in 5. Using a suitable cropping system and suitable tillage practices, keeping tillage to a minimum, and using stubble mulching are ways of conserving moisture. If these soils are used for crops, terraces, contour farming, and grassed waterways are among the practices that are needed to help control erosion. Because of steepness of slope and rapid runoff, these soils need more fertilizer than other soils in the county.

CAPABILITY UNIT IVe-2, DRYLAND

Soils in this capability unit are deep, well drained, and gently sloping to moderately sloping, and are on uplands. They have a surface layer of silty clay loam, clay loam, or silty clay and a subsoil of silty clay or clay.

These soils are moderately eroded to severely eroded. In some areas most of the surface layer has been removed by sheet erosion. Available water capacity is moderate to high. Permeability is slow, and runoff is rapid. The clayey subsoil is not easily penetrated by plant roots. During dry seasons these soils become hard, develop cracks, and are droughty. Content of organic matter is moderately low, and fertility is medium to low. If the soils are cultivated, the main concern of management is controlling runoff and erosion.

Dryland management.—The soils in this unit are not suitable for cultivation. They are droughty, and row crops grow poorly. If an adequate amount of moisture is maintained on the soil, small grains and legumes grow fairly well. Tillage is difficult, however, because of the moderately fine texture of the surface layer. Terraces, grassed waterways, and contour farming help to control erosion.

A cropping system that restricts row crops to 1 year and includes close-growing crops, legumes, and grasses helps to control erosion. Because of the slow rate of water release in these soils, heavy applications of fertilizer can damage crops during dry years. Leaving crop residues that include mulches on the soil helps to reduce soil cracking and evaporation of moisture.

These soils are better suited to permanent hay, pasture, range, windbreaks, and wildlife habitat than to cultivated crops. Some areas are suitable for farm ponds and erosion-control structures. These soils generally are not irrigated because water is not always available.

CAPABILITY UNIT IVe-4, DRYLAND

Only Pawnee soils, 3 to 7 percent slopes, severely eroded, is in this capability unit. These soils have a clayey surface layer and subsoil. Most of the original surface layer has been removed by sheet erosion.

Permeability of these soils is slow, and runoff is medium. Tillage is difficult because the surface is very sticky when wet and very hard when dry. Available water capacity is moderate, but moisture is released slowly to plants. Fertility and the content of organic matter are low. The main concerns of management are controlling runoff and water erosion and improving soil tilth, content of organic matter, and fertility.

Dryland management.—These soils are only fairly suited to cultivated crops because of poor tilth and alternating wetness and droughty conditions. The main crops are wheat, clover, alfalfa, and grain sorghum. These crops grow fairly well if a suitable seedbed can be prepared and if an adequate supply of moisture can be maintained in the subsoil. These soils are also suited to trees in windbreaks and to the development of wildlife habitat. Some areas are suitable for farm ponds.

A cropping system that consists mainly of close-growing crops, such as small grains, legumes, or legume-grass mixtures, helps to control erosion. A good cropping system includes growing legumes or grasses half of the time and protecting the soil with a cover crop the rest of the time. The amount of time in row crops needs to be restricted in the cropping sequence. Terraces contour farming, and grassed waterways help to control erosion. Commercial fertilizer and barnyard manure are needed to improve soil fertility, to provide for adequate plant growth, and for growing cover crops. Leaving crop residue as mulch on the surface helps to provide cover and control erosion. If intensive management that includes a suitable cropping system is not feasible, these soils are better kept in permanent grasses and used for hay and pasture.

CAPABILITY UNIT IVe-8, DRYLAND

Soils in this capability unit are deep and moderately sloping to strongly sloping and are on uplands. They have a surface layer of silty clay loam and clay loam.

Permeability of these soils is moderately slow. Available water capacity is high, and the soils release moisture readily to plants. Runoff is medium to rapid. Severe gully erosion has removed much of the original surface layer and in places much of the subsoil.

The main concern of management is controlling erosion. Fertility and the content of organic matter need to be increased. Runoff needs to be controlled.

Dryland management.—These soils are better suited to close-growing crops, such as wheat, alfalfa, and grasses, than to other crops. Other uses for these soils are pasture, range, trees, wildlife habitat, and recreational areas. Good management on these soils includes growing grasses and legumes most of the time to protect them from erosion. A few row crops should be included with the close-growing crops in the cropping system; however, row crops should be restricted to 1 year.

Lime, commercial fertilizer, and barnyard manure are needed to improve fertility on these soils.

Grassed field borders help to control weeds along turnrows and roadways. Most drainageways can be made into grassed waterways. Terracing, contour farming, and managing crop residue help to control erosion. A few gullies need structures to control erosion. Some gullies are suitable sites for farm ponds. These soils are not suitable for irrigated crops.

CAPABILITY UNIT IVe-11, DRYLAND

Soils in this capability unit are well drained and strongly sloping. They are on till uplands. The surface layer and the subsoil are clay loam.

Runoff is rapid on these soils. Available water capacity is high. Fertility is medium, and the content of organic matter is moderate to low. The hazard of erosion is slight to moderate.

Because gullies have formed in these strongly sloping soils, the use of large machinery is limited. The main concern of management is controlling sheet and gully erosion and maintaining the content of organic matter and fertility.

Dryland management.—Dryfarmed areas of these soils are suited to grain sorghum, corn, small grains, alfalfa, and grasses; but such close-growing crops as alfalfa, grasses, and wheat are better suited.

These soils are also suited to pasture or rangeland, windbreaks, wildlife, and recreational areas. Using a cropping system that limits the use of corn or sorghum to 1 year, alternating with small grains and hay crops, helps to control erosion. Terracing, farming on the contour, and using grassed waterways, crop residue, and mulch tillage are the practices that help to control erosion. If these soils are used for grassland, part of the yearly grass growth needs to be left on the surface after the grazing season to help to control water erosion.

Areas of these soils that contain gullies can be treated by land smoothing before installing terraces and a waterway system. Using barnyard manure and commercial fertilizer helps to increase the content of organic matter.

Irrigation management.—Irrigated areas of these soils are suited to alfalfa and grasses. Sprinkler irrigation is suitable, but only soils of less than 8 percent slopes are suitable for irrigation because of the severe hazard of water erosion and rapid runoff on these soils. Using terraces and grassed waterways are ways of helping to control erosion.

CAPABILITY UNIT IVe-81, DRYLAND; IVe-13, IRRIGATED

Hastings silty clay loam, 7 to 12 percent slopes, severely eroded, is the only soil in these capability units. Its subsoil is silty clay loam. Sheet and gully erosion have removed much of the surface layer and in places some of the subsoil.

Permeability of this soil is moderately slow. Available water capacity is high. Moisture is released readily to plants. Runoff is medium to rapid causing rills and small gullies in cultivated areas during heavy rains. Fertility and content of organic matter are low.

The main concern of management is controlling the rill and gully erosion. Fertility and content of organic matter need to be improved.

Dryland management.—Dryfarmed areas of this soil are better suited to such close-growing crops as small grains, alfalfa, and grasses than to row crops. Tame grasses and trees are well suited. This soil is also suitable for pasture, range, woodland, recreation, and as wildlife habitat. Row crops and corn can also be grown on this soil, but using these crops in the cropping system needs to be severely limited. A cropping system is needed that includes grain crops alternated with hay crops of grass or alfalfa. Terraces, contour farming, and grassed waterways help control erosion. Sheet and gully erosion can be controlled by using a cropping system that provides for all crop mulches on the land surface. Field borders and turnrows help slow runoff and erosion from field edges. Commercial fertilizer and barnyard manure applied to the soil help to produce sufficient crop residue for soil protection.

Irrigation management.—Irrigated areas of this soil are better suited to growing grasses and alfalfa than row crops. This soil is also suited for irrigated pastures. Sprinkler irrigation is suited to this soil. Because of the hazard of erosion, only slopes of less than 8 percent are suitable for irrigation. The rates of irrigation applications need to be limited to the intake rate of the soil. Fertilizer is needed for efficient crop growth and to produce sufficient residue for soil protection. Sloping and terracing gullied and eroded areas help to control erosion.

CAPABILITY UNIT IVw-2, DRYLAND; IVw-2, IRRIGATED

Scott silt loam is the only soil in these capability units. This soil is deep, nearly level, and very poorly drained. It is in upland depressions that are frequently flooded. It has a thin surface layer of silt loam and a subsoil of dense clay.

Excess water covers areas of this soil for part of the year. Because the soil is in basins that have no readily accessible outlets, drainage is difficult. Permeability is very slow. This soil absorbs water and releases moisture to plants slowly. The main concerns of management are preventing excess flood water and finding suitable outlets for drainage.

Dryland management.—If drainage is available, dryfarmed areas of this soil are suited to corn, sorghum, wheat, and tame grasses. Alfalfa is not frequently grown because it is sensitive to flooding. If satisfactory drainage cannot be established because of a lack of proper outlets, this soil is better left in native grasses and used for pasture, range, or as wildlife habitat, providing they can be maintained.

Terraces on the adjacent higher land help to control runoff and reduce flooding. In some places drainage ditches can be used where suitable outlets occur. Use of crop residue and barnyard manure helps to make this soil more friable.

Irrigation management.—Irrigated areas of this soil are suited to alfalfa, corn, sorghum, and tame grasses. If this soil is irrigated, the hazard of flooding needs to be eliminated. Flooding can be eliminated by terracing the surrounding higher land or by using drainage ditches. The soil can be kept friable and growth can be maintained by using a grass-alfalfa or alfalfa mixture in the cropping system each 4 to 6 years. Barnyard manure and green-manure crops help to increase the content of organic matter and to maintain fertility.

If land leveling operations are applied, furrow and border irrigation are suitable. Sprinkler irrigation is also suitable. Applications of irrigation water need to be adjusted to conform to the water intake rate of this soil.

CAPABILITY UNIT Vw-1, DRYLAND

Only Wet alluvial land is in this capability unit. This land type is nearly level, poorly drained, and on bottom lands. The water table is at or near the surface during most of the year. The soil material is mainly silty clay loam in the surface layer and silty clay or clay in the underlying material.

Permeability and runoff of this land type are slow. The soil material is generally too wet for cultivation, but during dry seasons the water table ranges from the surface to a depth of 24 inches.

This land type is used mainly for native hay and pasture and as food and cover for wildlife. Because of a lack of suitable outlets, drainage is not feasible. The main concern of management is excessive wetness.

CAPABILITY UNIT VIe-4, DRYLAND

Only Pawnee soils, 7 to 12 percent slopes, severely eroded, are in this capability unit. These soils are deep, moderately well drained, and moderately sloping and are on uplands. Their surface layer and subsoil range from clay loam to clay. They are sticky when wet and become very hard when dry. Because of rapid runoff, gullies form readily.

Permeability of these soils is slow. Available water capacity is moderate, and the soil releases moisture slowly to plants. The clayey subsoil restricts root penetration. Fertility and content of organic matter are low.

The main hazard on these soils is excessive erosion when the surface is exposed.

Dryland management.—These soils are better suited to native grasses than to crops. Grass on these areas can be used either for hay or for grazing. Because of the slope and the hazard of erosion, these soils are not suited to cultivation. These soils are also suitable for woodland and as wildlife habitat, depending on the needs of the particular farm. Some areas are suitable for farm ponds, but most of the acreage is used for grazing or for hay.

If these soils are used for grasses, grazing needs to be controlled. About 50 percent of each year's growth can be left on the soil at the end of the growing season to help give plants sufficient vigor for growing the following year and to provide the cover that protects the soils from erosion.

CAPABILITY UNIT VIe-8, DRYLAND

Soils in this capability unit are deep, well drained, and strongly sloping on uplands. They have a silty clay loam to clay loam surface layer and subsoil. These soils are eroded or severely eroded.

Permeability of these soils is moderately slow. Available water capacity is high. Runoff is rapid, and small gullies form easily. Moisture is released readily to plants.

The main concern of management is controlling severe erosion and managing runoff. An adequate cover needs to be maintained.

Dryland management.—Because these soils are steep and highly susceptible to water erosion, they are not suitable for cultivated crops. They are better suited to native grasses and converted to use for rangeland. These soils are used mostly for permanent hay or for grazing. They are also suitable for windbreaks, for farm ponds, and for use as wildlife habitat.

Areas of these soils that are now cultivated can be seeded to native grass mixtures and converted to range. Maintaining a cover of vegetation is needed on the soil surface when the grasses are seeded.

Grazing needs to be regulated. Leaving about half of the current growth of desirable grasses on the surface helps to control grazing. Spraying and mowing can control weeds and undesirable plants.

CAPABILITY UNIT VIe-9, DRYLAND

Soils in this capability unit are deep, well drained, and strongly sloping to steep. They are on uplands and on occasionally flooded areas of narrow bottom lands along major drainageways. They have a surface layer of silt loam, clay loam, or silty clay loam. The subsoil and underlying material are clay loam or silty clay loam.

The soils on uplands have a thin surface layer that is moderate to low in fertility. Permeability is moderately low, available water capacity is high, and the soils release moisture readily to plants. Runoff is rapid, and small gullies form easily. The alluvial areas contain dark, highly fertile soils that receive runoff from the steeper valley slopes.

The main concerns of management are controlling excessive erosion and maintaining an adequate cover of vegetation.

Dryland management.—Soils in this unit are not suited to cultivated crops because of steep slopes and rapid runoff. These soils are better suited to native grasses and to range than to cultivated crops.

Grazing needs to be controlled to maintain an adequate vegetative cover. Leaving about half of the current growth of desirable grasses on the surface at the end of the growing season helps to control grazing. Mowing or spraying can be used to help to control woody plants.

CAPABILITY UNIT VIs-4, DRYLAND

Only Meadin soils, 7 to 31 percent slopes, eroded, are in this capability unit. These soils are shallow and have a loam to loamy sand surface layer and a coarse sand and gravel substratum. They are on uplands.

Permeability of these soils is rapid. These soils absorb water readily, but their available water capacity is low.

TABLE 2.—*Predicted average acre yields*

[Yields in columns A are those expected under ordinary management; yields in columns B are those expected under improved

Soil	Corn				Grain Sorghum	
	Dryland		Irrigated		Dryland	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Breaks-Alluvial land complex						
Burchard clay loam, 7 to 12 percent slopes	56	73			54	72
Burchard clay loam, 7 to 12 percent slopes, eroded	53	68			52	70
Burchard-Steinauer clay loams, 12 to 17 percent slopes	43	55			42	62
Burchard-Steinauer clay loams, 12 to 17 percent slopes, eroded	40	52			38	58

They generally are too droughty for most crops. Fertility is low.

The main limitations of these soils are severe water erosion, low fertility, and droughtiness.

Dryland management.—These soils are not suited to cultivated crops. They are better suited to native grasses that are managed as range. Certain kinds of trees are suitable for windbreaks.

Grazing needs to be controlled to maintain an adequate vegetative cover. Leaving about half of the current growth of desirable grasses on the surface at the end of the growing season helps to control grazing. Weeds and undesirable woody plants can be controlled by spraying and mowing.

CAPABILITY UNIT VIw-1, DRYLAND

Only Silty alluvial land is in this capability unit. It is deep, frequently flooded soil material on bottom lands and along upland drainageways. Also in this unit are areas of steep banks and meandering stream channels. Both the surface layer and substratum range from silt loam to silty clay in texture.

The main concern of management is controlling the frequent flooding.

Dryland management.—This land type is not suited to cultivation because of the severe hazard of flooding. It is suitable for rangeland, trees, wildlife, and recreational areas. Controlling flooding generally is not feasible because of excessive flooding.

CAPABILITY UNIT VIIe-1, DRYLAND

Soil material in this capability unit is very steep and excessively drained and is on glacial and loessial uplands. The surface layer and substratum range from loam or silt loam to clay loam or silty clay loam.

The very steep slopes and the rapid runoff have caused deep, active gullies and, in some places, catsteps. The main concerns of management are controlling erosion and reducing runoff.

Dryland management.—Areas of this soil material are better suited to wildlife habitat or to growing trees in windbreaks than to cultivated crops. Native grasses used as range are also suitable.

Establishing and maintaining a cover of grasses or trees is needed on these areas. The grasses and trees help to limit grazing and to control brush. Selective cutting and protecting the areas from fire and grazing are needed to maintain a good stand of trees.

CAPABILITY UNIT VIIIw-1, DRYLAND

Only Marsh is in this unit. It consists of areas that generally are near the center of large basins and receive runoff from surrounding higher areas.

Water is ponded on the surface of Marsh to a depth of 1 to 12 inches for 1 to 2 months when rainfall is below normal, and it covers the areas for several months or for the entire year when rainfall is above normal. Most of the water is slowly removed because the very slowly permeable subsoil restricts penetration of water and the areas continuously receive water from other areas.

Marsh is well suited to wetland wildlife. Vegetation covers most areas, but some small intermittent lakes and other areas are periodically dry and lack vegetation. Cattails, rushes, and sedges commonly grow on Marsh, and in some areas, reed canarygrass and willows grow near the outer edges.

The main concern in managing Marsh is excess water. If the areas are managed for wildlife, however, the excess water is beneficial. Drainage is difficult to install because of the lack of suitable outlets.

Predicted Yields

The predicted average acre yields of the principal crops grown on the soils of Seward County are given in table 2. These estimates are based on information obtained from farmers in the county, supervisors of the Soil and Water Conservation District, representatives of the Soil Conservation Service, and from observations and comparisons made by Extension Service personnel and others who are familiar with the soils and farming in the survey area. The averages are based on seeded acres for a 10-year period. They take into account the years of good moisture supply as well as the poor, and also the probable loss through hail and insects.

The predicted yields in table 2 are listed under two levels of management. The figures in columns A represent yields that can be expected under ordinary management, and those in columns B represent yields under improved management.

of principal irrigated and dryland crops

management. Absence of an entry means that the crop is not suited to the soil or that it is grown only in small amounts]

Grain Sorghum—Con.		Wheat		Soybeans				Alfalfa			
Irrigated		Dryland		Dryland		Irrigated		Dryland		Irrigated	
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
--------	--------	31	41	33	40	--------	--------	3.8	4.8	--------	--------
--------	--------	28	38	30	37	--------	--------	3.7	4.7	--------	--------
--------	--------	26	31	37	35	--------	--------	3.5	4.5	--------	--------
--------	--------	22	27	22	30	--------	--------	3.3	4.3	--------	--------

TABLE 2.—*Predicted average acre yields*

Soil	Corn Dryland A	Corn Dryland B	Corn Irrigated A	Corn Irrigated B	Grain Sorghum Dryland A	Grain Sorghum Dryland B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Butler silt loam	45	60	90	120	60	70
Butler silt loam, terrace	47	62	92	122	62	72
Butler-Slickspots complex	32	45	72	92	36	52
Crete silt loam, 0 to 1 percent slopes	50	65	98	125	64	75
Crete silt loam, 1 to 3 percent slopes	45	60	90	120	61	72
Crete silt loam, terrace, 1 to 3 percent slopes	47	62	95	122	62	73
Fillmore silt loam	40	55	85	105	45	65
Geary silty clay loam, 3 to 7 percent slopes, eroded	55	72			61	76
Geary silty clay loam, 7 to 12 percent slopes, eroded	46	66			52	72
Geary silty clay loam, 7 to 12 percent slopes, severely eroded	41	61			56	74
Geary silty clay loam, 12 to 31 percent slopes, severely eroded						
Hall silt loam, 0 to 1 percent slopes	68	85	120	147	73	88
Hall silt loam, 1 to 3 percent slopes	63	80	110	132	65	78
Hall-Slickspots complex, 1 to 3 percent slopes	53	70	70	96	55	68
Hastings silt loam, 0 to 1 percent slopes	65	82	120	145	72	87
Hastings silt loam, 1 to 3 percent slopes	63	78	108	130	67	83
Hastings silty clay loam, 1 to 3 percent slopes, eroded	60	76	95	115	65	81
Hastings silty clay loam, 3 to 7 percent slopes, eroded	56	72	85	110	62	78
Hastings silty clay loam, 7 to 12 percent slopes, eroded	49	65			51	70
Hastings silty clay loam, 3 to 7 percent slopes, severely eroded	50	70	75	95	48	70
Hastings silty clay loam, 7 to 12 percent slopes, severely eroded	43	63			46	63
Hastings silty clay loam, 12 to 17 percent slopes, severely eroded						
Hastings silty clay loam, terrace, 3 to 7 percent slopes, eroded	58	76	87	112	63	79
Hastings soils, 1 to 3 percent slopes, severely eroded	51	71	70	90	53	73
Hobbs silt loam, occasionally flooded	58	73			60	75
Hobbs silt loam, 0 to 1 percent slopes	69	86	120	148	72	88
Hobbs silt loam, 1 to 3 percent slopes	65	80	110	132	66	81
Hobbs silt loam, 3 to 7 percent slopes	60	75	88	112	58	78
Hobbs silty clay loam, 0 to 1 percent slopes	67	84	115	145	70	87
Hord silt loam, 0 to 1 percent slopes	70	87	120	150	72	89
Lamo silty clay loam	50	70			55	75
Longford silty clay loam, 5 to 12 percent slopes, eroded	35	50			49	64
Marsh						
Meadin soils, 7 to 31 percent slopes, eroded						
Morrill clay loam, 7 to 12 percent slopes, eroded	52	67			50	68
Pawnee clay loam, 3 to 7 percent slopes	46	58			52	70
Pawnee clay loam, 3 to 7 percent slopes, eroded	44	56			50	68
Pawnee clay loam, 7 to 12 percent slopes	40	52			50	64
Pawnee clay loam, 7 to 12 percent slopes, eroded	38	50			47	62
Pawnee soils, 3 to 7 percent slopes, severely eroded	30	44			45	60
Pawnee soils, 7 to 12 percent slopes, severely eroded	27	42			40	55
Rough broken land, loess						
Rough broken land, till						
Scott silt loam	24	40			28	40
Sharpsburg silty clay loam, 3 to 7 percent slopes, eroded	58	78	87	113	64	80
Sharpsburg silty clay loam, 3 to 7 percent slopes, severely eroded	53	72	83	97	58	74
Sharpsburg silty clay loam, 7 to 12 percent slopes, eroded	52	71			57	75
Sharpsburg silty clay loam, 7 to 12 percent slopes, severely eroded	48	68			53	68
Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded	42	59			45	61
Shelby clay loam, 5 to 12 percent slopes, eroded	58	75			63	79
Shelby clay loam, 7 to 12 percent slopes	55	70			56	73
Silty alluvial land						
Steinauer clay loam, 7 to 12 percent slopes, eroded	43	58			46	66
Steinauer clay loam, 12 to 31 percent slopes						
Steinauer clay loam, 12 to 31 percent slopes, eroded						
Wet alluvial land						
Wymore silty clay loam, 0 to 1 percent slopes	53	68	101	127	62	77
Wymore silty clay loam, 1 to 3 percent slopes	50	64	97	122	59	74
Wymore silty clay loam, 3 to 7 percent slopes, eroded	46	60	84	107	52	68
Wymore soils, 7 to 9 percent slopes, eroded	37	52			44	59

of principal irrigated and dryland crops—Continued

Grain Sorghum—Con.		Wheat		Soybeans				Alfalfa			
Irrigated		Dryland		Dryland		Irrigated		Dryland		Irrigated	
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
85	110	34	41	33	41	42	52	3. 8	4. 8	4. 8	5. 8
87	112	35	42	34	42	43	53	3. 9	4. 9	4. 9	5. 9
65	87	24	30	21	29	32	40	3. 5	4. 4	4. 5	5. 5
90	115	35	44	35	43	44	54	4. 0	5. 0	5. 0	6. 0
87	107	34	41	32	40	42	50	3. 8	4. 8	4. 8	5. 8
88	110	35	44	33	41	43	51	3. 9	4. 9	4. 9	5. 9
82	100	28	36	34	42	43	50	2. 9	3. 9	4. 0	5. 0
----	----	34	42	34	43	----	----	3. 9	4. 9	----	----
----	----	32	40	31	37	----	----	3. 5	4. 5	----	----
----	----	21	28	27	34	----	----	2. 8	3. 8	----	----
----	----	----	----	----	----	----	----	----	----	----	----
110	135	40	47	44	52	52	60	4. 6	5. 6	5. 5	6. 5
100	125	38	45	39	49	48	56	4. 3	5. 3	5. 1	6. 2
85	105	34	41	32	40	36	46	3. 9	4. 9	4. 7	5. 8
108	135	40	47	40	48	50	58	4. 6	5. 6	5. 5	6. 5
94	124	38	45	38	46	48	56	4. 4	5. 4	5. 3	6. 3
88	115	37	44	36	44	46	54	4. 2	5. 2	5. 0	6. 0
85	110	36	42	34	43	44	53	4. 0	5. 0	4. 9	5. 9
----	----	34	40	31	38	----	----	3. 6	4. 6	----	----
80	97	34	40	32	39	40	47	3. 8	4. 8	4. 7	5. 7
----	----	28	36	27	35	----	----	3. 3	4. 3	----	----
----	----	----	----	----	----	----	----	----	----	----	----
87	112	37	44	35	44	45	54	3. 7	5. 3	5. 0	6. 0
78	98	32	38	32	40	42	49	3. 9	4. 9	4. 8	5. 7
----	----	32	40	34	42	----	----	3. 6	5. 2	----	----
110	135	40	47	44	51	52	60	4. 6	5. 6	5. 5	6. 5
95	127	38	45	39	47	48	56	4. 0	5. 0	5. 0	6. 0
88	110	35	41	35	43	44	52	3. 7	4. 7	4. 8	5. 8
105	132	40	47	41	49	50	58	4. 6	5. 6	5. 5	6. 5
107	135	41	48	44	52	52	60	4. 6	5. 6	5. 5	6. 5
----	----	36	42	34	42	----	----	4. 0	5. 0	----	----
----	----	28	38	25	34	----	----	2. 9	3. 9	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	30	39	31	38	----	----	3. 2	4. 2	----	----
----	----	30	40	30	37	----	----	3. 4	4. 4	----	----
----	----	29	39	28	35	----	----	3. 2	4. 2	----	----
----	----	27	37	25	32	----	----	3. 0	4. 0	----	----
----	----	25	35	23	30	----	----	2. 8	3. 8	----	----
----	----	23	33	21	28	----	----	2. 7	3. 7	----	----
----	----	20	27	18	24	----	----	2. 4	3. 4	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	14	20	18	24	----	----	1. 6	2. 4	----	----
87	112	38	44	35	44	45	54	4. 4	5. 2	5. 0	6. 0
77	102	36	41	31	40	41	48	3. 8	4. 8	4. 8	5. 8
----	----	35	42	32	39	----	----	3. 5	4. 5	----	----
----	----	32	37	28	36	----	----	3. 2	4. 3	----	----
----	----	28	33	24	32	----	----	2. 8	3. 9	----	----
----	----	35	42	33	42	----	----	3. 5	4. 4	----	----
----	----	37	44	29	37	----	----	3. 5	4. 5	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	27	35	25	34	----	----	3. 3	4. 3	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----
----	----	----	----	----	----	----	----	----	----	----	----
92	117	37	42	36	44	45	55	4. 1	5. 1	5. 0	6. 0
89	110	35	41	33	41	43	51	3. 9	4. 9	4. 9	5. 9
83	102	33	36	28	37	37	46	3. 4	4. 4	4. 6	5. 6
----	----	25	33	22	30	----	----	3. 0	4. 0	----	----

The yield data in columns A are those obtained by most farmers in the county. Ordinary management includes the use of moderate amounts of fertilizer and lime. The supply of organic matter, control of erosion, maintenance of soil tilth and soil nitrogen are most likely less than the optimum requirements. Such cultural practices as weed, disease, and insect control, and use of certified seed may or may not be used. Improvement in better crop varieties, higher plant population, timeliness of planting, fertilizing, irrigating, and harvesting are likely to result in significant increases in productivity.

The yield data in columns B are obtained under improved management. This high level of management includes use of practices for controlling soil blowing and water erosion; use of cropping sequences that provide for maintaining tilth and content of organic matter; applying fertilizer as indicated by soil tests; planting adapted crop varieties at the proper rate; controlling insects, weeds, and diseases; and adding limestone, phosphate, nitrogen, and other minor fertilizers that soil tests and experience indicate are needed. Improved management also includes efficient use of crop residue in a good cropping system.

Management of the Soils for Range [3]

About 10 percent of the total acreage of farmland in Seward County is used as range (fig. 24). Range is located throughout the county but is somewhat concentrated in the eastern part. Most of it is not suitable for cultivation. Managing the range so that the reserve of feed and grass are used to their best advantage is important to the success of the rangeland program.

[3] By Peter N. Jensen, range conservationist, Soil Conservation Service.

Range sites and condition classes

Range sites are distinctive kinds of rangeland that have different potentials for producing native plants. Within a given climate, the sites differ significantly only in the kind or amount of plants they produce. A significant difference is one that is great enough to require different management to maintain or improve the vegetation.

The kind and amount of plants a site produces depend on the level of soil fertility, on the amount of air that enters the soil, and on the amount of water that is taken in and retained in the root zone. A range site, therefore, can be identified by the kinds of soil known to have the capability for producing the plants that make up the distinctive plant community characteristic of a specific site.

Livestock tend to graze the most palatable and nutritious plants first. In determining the condition class of their range sites, farmers and ranchers group plants according to plant response to the degree of grazing received. These groups of plants are called *decreasers*, *increasers*, and *invaders*.

Decreaser plants are members of the potential community that decrease under continued moderately heavy to heavy grazing. Most of these plants have a high grazing preference. The total of all such species is counted in determining range condition class.

***Figure 24.*—Rangeland on an area of Burchard clay loam in the eastern part of Seward County.**

Increaser plants are in the potential plant community and increase in abundance under continued moderately heavy to heavy grazing. Some increasers of moderately high grazing preference initially increase and then decrease as grazing continues. Others of low grazing preference continue to increase. Only the percentage of increaser plants expected to occur in the potential plant community are counted in determining range condition.

Invader plants are not members of the potential plant community. They invade the community as the condition of the range declines. Invaders are annuals, perennials, grasses, weeds, and woody plants. A few have high grazing value, but many are worthless. Invader plants are not counted in determining range condition class.

Range condition is the present state of the plants of a range site in relation to the potential plant cover for the site. *Range condition classes* measure the degree to which the plant composition, expressed in percentage, resembles that of the potential plant community of a range site. A range is in *excellent* condition if 76 to 100 percent of the existing plants consists of the original or climax plants; in *good* condition if 51 to 75 percent consists of climax plants; in *fair* condition if 26 to 50 percent consists of climax plants; and in *poor* condition if less than 25 percent consists of climax plants.

Grazing practices that help to maintain or to improve range condition are needed on all rangeland in the survey area. Suitable practices are: (a) proper grazing use, (b) range deferred grazing, and (c) range rotation-deferred grazing. The proper distribution of livestock in a pasture can be improved by correctly locating: (a) fences, (b) livestock water developments, and (c) salting facilities.

On some sites in the county, range condition can be improved by range seeding. Native grasses, either wild harvest or improved varieties, can be seeded or reseeded on soils suitable for use as range. For example, Hastings silty clay loam, 12 to 17 percent slopes, severely eroded, and Pawnee soils, 7 to 12 percent slopes, severely eroded, are used for crops; but if these soils are seeded to a mixture of native warm-season grasses they are suitable for use as range. These soils are suited to a mixture of big bluestem, little bluestem, indiangrass, switchgrass, and side-oats grama.

Descriptions of range sites

In the pages that follow, the range sites in Seward County are discussed, and the principal grasses on these range sites are named. These grasses are those grown on the site if it is in excellent condition. Also given for each site is the annual yield of air-dry forage if the site is in excellent condition. These yields can be expected to vary according to the rainfall received each year. Past grazing and damage by rodents and insects also affect the annual yields. The soils in each site are indicated in the "Guide to Mapping Units" at the back of this survey.

WET LAND RANGE SITE

Only Wet alluvial land is in this range site. This land type consists of soil material on bottom lands or in depressions. The soil material ranges from silt loam to silty clay in texture, and in places it is calcareous. The water table ranges from the surface to a depth of 3 feet for most of the year and is generally above the surface for part of the growing season.

If this site is in excellent condition, the principal plants are prairie cordgrass and sedges.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 6,500 pounds per acre in unfavorable years to 7,500 pounds per acre in favorable years.

SUBIRRIGATED RANGE SITE

Lamo silty clay loam is the only mapping unit in this range site. It is nearly level and is on bottom lands. Both the surface layer and subsoil are silty clay loam, and the soil is calcareous. The water table is at a depth of 24 to 60 inches, and it rarely covers the surface but remains within the root zone during the growing season.

The principal grasses on this range site when it is in excellent condition are big bluestem, indiangrass, switchgrass, prairie cordgrass, and members of the sedge family.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 5,500 pounds per acre in unfavorable years to 6,500 pounds per acre in favorable years.

SILTY OVERFLOW RANGE SITE

In this range site are soils and land types on flood plains. The surface layer and the subsoil of these soils are silt loam to silty clay loam. These soils are subject to periodic flooding.

If this site is in excellent condition, the principal grasses are big bluestem, switchgrass, indiangrass, and western wheatgrass.

If this site is in excellent condition and rainfall is average, the total annual yield of air-dry forage on this site ranges from 4,500 pounds per acre in unfavorable years to 5,500 pounds per acre in favorable years.

CLAYEY OVERFLOW RANGE SITE

Only Fillmore silt loam is in this range site. It is nearly level and is in depressions on uplands. The surface layer is silt loam, and the subsoil is silty clay. This soil is subject to flooding from overflow. Runoff is slow, and this soil is poorly drained.

If this site is in excellent condition, the principal grasses are big bluestem, switchgrass, indiangrass, and western wheatgrass.

If this site is in excellent condition and rainfall is average, the total annual yield of air-dry forage on this site ranges from 4,500 pounds per acre in unfavorable years to 5,500 pounds per acre in favorable years.

SILTY LOWLAND RANGE SITE

In this range site are soils on bottom lands and stream terraces. These soils have a surface layer and a subsoil of silt loam or silty clay loam. They receive additional moisture from higher slopes and infrequent flooding.

If this site is in excellent condition, the principal grasses are big bluestem, indiangrass, switchgrass, little bluestem, and western wheatgrass.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 4,000 pounds per acre in unfavorable years to 5,500 pounds per acre in favorable years.

SALINE LOWLAND RANGE SITE

Only Slickspots are in this range site. The areas are on stream terraces. The surface layer and the subsoil range from silt loam to silty clay loam. Additional moisture is received from higher slopes and from infrequent flooding. Slickspots are affected by moderate to high amounts of soluble salts and exchangeable sodium.

If this site is in excellent condition, the principal grasses are switchgrass, indiangrass, western wheatgrass, and Canada wildrye.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 3,500 pounds per acre in unfavorable years to 5,000 pounds per acre in favorable years.

SILTY RANGE SITE

In this site are nearly level to steep soils on uplands and stream terraces. These soils have a surface layer and a subsoil of silt loam, silty clay loam, or clay loam.

If this site is in excellent condition, the principal grasses are big bluestem, little bluestem, indiangrass, switchgrass, and side-oats grama.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 3,500 pounds per acre in unfavorable years to 4,500 pounds per acre in favorable years.

CLAYEY RANGE SITE

This range site consists of nearly level to moderately sloping soils on stream terraces and uplands. These soils have a surface layer of silt loam, clay loam, or silty clay loam and a subsoil of silty clay or clay. The infiltration rate is slow in these soils.

If this site is in excellent condition, the principal grasses are big bluestem, little bluestem, switchgrass, indiangrass, and side-oats grama.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 2,500 pounds per acre in unfavorable years to 4,500 pounds per acre in favorable years.

LIMY UPLAND RANGE SITE

In this range site are moderately sloping to steeply sloping soils on uplands. These soils have a clay loam surface layer and subsoil. They are slightly calcareous to strongly calcareous at or near the surface and in the subsoil.

If this site is in excellent condition, the principal grasses are little bluestem, big bluestem, side-oats grama, switchgrass, and indiangrass.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 2,000 pounds per acre in unfavorable years to 4,000 pounds per acre in favorable years.

SHALLOW TO GRAVEL RANGE SITE

Only Meadin soils, 7 to 31 percent slopes, eroded, are in this range site. These soils are gently sloping to steep and are on uplands. The surface layer of these shallow soils ranges from loam to loamy sand. These soils are 10 to 20 inches deep over coarse mixed sand and gravel.

If this site is in excellent condition, the principal grasses are little bluestem, blue grama, big bluestem, and switchgrass.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 2,000 pounds per acre in unfavorable years to 3,500 pounds per acre in favorable years.

DENSE CLAY RANGE SITE

In this range site are severely eroded, gently sloping to moderately sloping soils on uplands. These deep soils have a surface layer of clay loam or clay, about 4 to 6 inches thick, and a dense massive silty clay to clay subsoil. Movement of water through the subsoil is restricted, and the amount of water available for plant use is limited.

The principal grasses on this range site when it is in excellent condition are switchgrass, big bluestem, little bluestem, and indiangrass.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage is 2,000 pounds per acre in unfavorable years to 4,000 pounds per acre in favorable years.

THIN LOESS RANGE SITE

Only Rough broken land, loess, is in this range site. This land type is very steep and has many catsteps and land slips. The deep, loessial soil material has a surface layer and underlying material of silt loam. It is moderately calcareous to strongly calcareous.

The principal grasses on range in excellent condition are little bluestem, side-oats grama, big bluestem, and switchgrass.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry forage on this site ranges from 2,000 pounds per acre in unfavorable years to 3,000 pounds per acre in favorable years.

Management of the Soils for Windbreaks [4]

This section gives information about the planting and care of tree windbreaks in relation to the soils of Seward County. Most of the trees planted in the county are in windbreaks. The few remaining natural stands of trees are mostly on Silty alluvial land on the bottom lands along the Blue River and small streams in the county. Common species in these natural stands are cottonwood, willow, elm, ash, hackberry, walnut, boxelder, bur oak, cedar, plum, and maple. Originally the native stands occupied most of what is now Silty alluvial land, Lamo silty clay loam, Hobbs silt loam, 0 to 1 percent slopes, and Hobbs silt loam, occasionally flooded. Most of these areas were cleared and used for crops by the turn of the century. In the eastern part of the county, scattered stands of bur oak remain on areas of Rough broken land, till.

The first settlers of Seward County planted trees to provide protection, shade, and posts. Throughout the years landowners have continued to plant trees to protect their buildings, to shelter their livestock, and to protect their soils and crops.

[4] By James W. Carr, Jr., forester, Soil Conservation Service.

Kinds of windbreaks

Windbreaks generally are of two kinds: farmstead and field. If farmstead windbreaks are properly designed and located, they control drifting snow and keep it out of farmyards. They also shelter homes, farmyards, and livestock feedlots from winds. In addition, the trees provide cover for wildlife and increase the value of farms (fig. 25).

Field windbreaks are effective in helping to control soil blowing on cropland, especially on somewhat sandy soils. In some years windbreaks help to increase crop yields by protecting crops from hot winds that dry out and otherwise damage plants. Field windbreaks are more effective when they are used along with other good management. Field windbreaks generally are one or two rows wide and 20 to 40 rods apart.

Planting of windbreaks

Most soils should be prepared for windbreaks in the same manner as they are for ordinary field crops. If plowpans have formed in the soils, the soils should be deep-plowed. The soils need to be prepared early enough to permit them to settle before planting the trees. A soil that has been in alfalfa-grass sod needs at least a year of summer fallow before trees are planted. The most effective windbreak is carefully planned. The site is staked out before the trees are planted. Seedlings chosen for planting are preferably those kinds of trees and shrubs that grow best on the kinds of soil where the windbreak is to be established. The windbreak suitability groups described later in this section give suitable trees and shrubs for the soils in each group. Healthy seedlings, grown from seeds purchased locally, should be acquired at reputable nurseries. Plant windbreaks in spring, protect the roots from drying out during planting, and pack the ground firmly around the roots.

Young trees need considerable care if they are to survive and do well on the prairie soils of Seward County. Rainfall is somewhat limited and irregular, and for this reason weeds need to be controlled so that they do not compete with the trees for moisture. Cultivation or chemicals can be used to kill weeds. Trees must be protected from livestock and fire, and young trees need protection from rabbits.

Windbreak suitability groups

The kind of soil and the soil-air-moisture relationship greatly influence the growth of trees in this survey area.

***Figure 25.*—An all-conifer windbreak planted to give protection from winter storms. This windbreak is in an area of the Pawnee-Sharpsburg association.**

Trees generally grow better on moderately coarse textured soils than on soils of other textural classes. Tree growth is fair to poor on fine-textured soils because these soils absorb and release moisture very slowly. Coarse-textured soils are not well suited to trees because they do not store enough nutrients and water for plants. Deep soils are better suited to trees than shallow soils because deep soils absorb and hold more water for use during periods of drought.

Choice of planting stock is a part of good management. Hardwoods, for example, need a better soil than conifers. Two kinds of hardwoods—Siberian elm and American elm—were once planted extensively in this county, but they are no longer considered suitable. The Siberian elm is short lived and spreads rapidly by seed onto cropland. The American elm is susceptible to Dutch elm disease.

A good windbreak must be designed for a specific purpose, and it must be adapted to the soils of the site. Specific information on the design, planting, and care of windbreaks is available from the Soil Conservation Service and Extension Service representatives serving the county.

The soils of Seward County have been grouped according to the characteristics that affect tree growth. The group to which each soil belongs is listed in the "Guide to Mapping Units." In the pages that follow, the soils in each windbreak group and the trees and shrubs suitable for them are briefly discussed.

The data in table 3 show the expected growth of trees that are suitable for windbreaks. These estimates are based on detailed measurements of trees grown on the soils in three of the major windbreak suitability groups represented in the county.

SILTY TO CLAYEY WINDBREAK SUITABILITY GROUP

This group consists of deep, somewhat poorly drained, moderately well drained, and well drained soils that are nearly level to steep. These soils are in the Burchard, Butler, Crete, Geary, Hall, Hastings, Hobbs, Hord, Longford, Morrill, Pawnee, Sharpsburg, Shelby, Steinauer, and Wymore series. Soils that have a medium-textured to fine-textured surface layer and a fine-textured subsoil are in the Butler, Crete, Longford, Pawnee, and Wymore series. These soils have a slowly permeable subsoil that readily releases moisture to plants. Soils that have a moderately fine textured surface layer and subsoil are in the Burchard, Geary, Hall, Hastings, Hobbs, Morrill, Sharpsburg, Shelby, and Steinauer series. The subsoil of these soils is moderately permeable, and it releases moisture very readily to plants. Available water capacity of the soils in this windbreak group ranges from moderate to high.

The soils in this group generally provide good sites for planting trees. Survival of planted trees and growth of adapted species are good. Drought and competition for moisture from weeds and grasses are the main hazards to planted trees. In some sloping areas water erosion is also a hazard.

Conifers suitable for planting on these soils are eastern redcedar, ponderosa pine, Austrian pine, and Scotch pine. Broadleaf trees suitable for planting are green ash, hackberry, bur oak, and honeylocust. Suitable shrubs are cotoneaster, chokecherry, honeysuckle, lilac, and autumn olive.

MODERATELY WET WINDBREAK SUITABILITY GROUP

This group consists of deep soils that are moderately wet because they have a moderately high water table or they are subject to flooding for short periods. These soils are in the Fillmore, Hobbs, and Lamo series. Silty alluvial land is also in this group. The nearly level Fillmore soils are in depressions, and the areas are occasionally ponded. Permeability is slow in the subsoil, and moisture is released slowly to plants. The occasionally flooded Hobbs soils have a medium-textured surface layer and subsoil that are moderately permeable, and moisture is released readily to plants. The Lamo soils have a moderately fine textured surface layer and underlying layers. Permeability is moderately slow in these soils. A seasonal water table is at a depth of 30 to 60 inches. Silty alluvial land is on the bottom of narrow drainageways. It is frequently flooded for short periods. These soils are suited to trees that can tolerate wetness. Trees grow as well on this soil as they do on the other soils of this group.

TABLE 3.—*Estimated height of trees, at 20 years of age, grown in the soils in the major windbreak suitability groups*

[Data are not provided for the Very Wet, the Moderately Saline-Alkali, and the Undesirable windbreak suitability groups, because windbreaks are generally not needed on the soils in these groups. Absence of an entry means that no determination was made or that the soils are not suited to the specific tree]

Species	Windbreak suitability group					
	Silty to Clayey		Moderately Wet		Shallow	
	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height
		Feet		*Feet*		*Feet*
Eastern redcedar	Excellent	19	Excellent	19	Excellent	15
Ponderosa pine	Excellent	24			Excellent	20
Green ash	Good	24				
Hackberry	Good	20				
Honeylocust	Good	26				
Cottonwood			Good	58		

Trees and shrubs that are suitable for planting on the soils in this group are eastern redcedar, Scotch pine, honeylocust, hackberry, green ash, cottonwood, sycamore, golden willow, white willow, black walnut, buffaloberry, eastern chokecherry, plum, and red osier dogwood.

SHALLOW WINDBREAK SUITABILITY GROUP

Only Meadin soils, 7 to 31 percent slopes, eroded, are in this group. These soils are shallow and have a limited root zone above the underlying mixed sand and gravel. These soils are suited to limited planting of eastern redcedar.

VERY WET WINDBREAK SUITABILITY GROUP

Only Wet alluvial land is in this group. It is on bottom lands. The areas are wet most of the year because of a water table that is at or near the surface or because of frequent flooding. Because this land type lacks good drainage outlets, it is difficult to lower the water table.

Only trees and shrubs that can tolerate wetness are suitable for planting. Among the trees and shrubs that are suitable are diamond willow, white willow, golden willow, cottonwood, red osier dogwood, and buffaloberry.

MODERATELY SALINE-ALKALI WINDBREAK SUITABILITY GROUP

This group consists of deep, nearly level soils on stream terraces. These soils are affected by a moderate amount of soluble salts and exchangeable sodium. The Slickspots parts of the Butler-Slickspots complex and the Hall-Slickspots complex are in this group. These soils have slow permeability.

Only those trees and shrubs that can tolerate a moderate amount of salts and exchangeable sodium are suitable to be planted on the soils in this group. Trees and shrubs suitable for planting are eastern redcedar, Austrian pine, green ash, honeylocust, cottonwood, Russian-olive, skunkbush sumac, and buffaloberry.

UNDESIRABLE WINDBREAK SUITABILITY GROUP

In this group are soils of the Scott series; the land type Marsh in upland depressions or in basins; and the land types Rough broken land, loess, and Rough broken land, till, in breaks or gullies on uplands. The Scott soils have a claypan subsoil and are very slowly permeable. Marsh is covered by water during the critical months of the growing season during years when rainfall is normal. Rough broken land, loess, and Rough broken land, till, are very steep.

The soils in this group generally are not suited to windbreak planting of any kind because of their unfavorable qualities and characteristics. Some areas can be used for wildlife planting of trees or shrubs that tolerate wetness if the plants are planted by hand or if they are established when water is not ponded on the areas.

Management of the Soils for Wildlife and Recreation [5]

Management of soils for wildlife requires a knowledge of the soils and the climate of the area and of the kinds of vegetation that can grow on the soils. The kind, abundance, and distribution of vegetation largely determine the kind and amount of wildlife that can be produced and maintained.

The wildlife carrying capacity of an area is influenced by the relief of the area and by such soil characteristics as fertility and permeability. Fertile soils generally produce more wildlife than infertile soils, and the water that drains from fertile soils generally produces more fish than that drained from infertile soils.

Relief affects wildlife by its influence on how soils are used. Steep or rough, irregularly shaped tracts that are not suitable for farming can be hazardous for livestock. Undisturbed vegetation on these areas, however, can provide food and protective cover for wildlife. Large, open, farmed areas of nearly level and gently sloping soils lack the interspersion of undisturbed odd areas; but they provide additional food, in the form of seeds left after harvest, needed for certain species of wildlife.

Permeability and the rate of water infiltration through the soils are important characteristics to be considered in evaluating the use of soils for fish ponds and in developing and maintaining wetland habitat for waterfowl. Marshy areas are suitable for developing aquatic and semiaquatic habitat for waterfowl and some species of furbearers.

The soil associations in Seward County provide suitable habitat for a variety of game and nongame birds and mammals. In addition, many of the associations have potential for development as recreational areas. For descriptions of the associations and detailed information about the use and management of the soils in each association, refer to the descriptions of the soil associations in the front of this survey.

The wooded tracts of soils along the stream terraces and on the bottom lands in the Hobbs-Hall association provide habitat for songbirds and such game species as deer, bobwhite quail, squirrel, and cottontail rabbit. This association is also inhabited by furbearers that require water, such as mink, muskrat, and beaver. Although water is sometimes scarce for these furbearers, habitat is abundant for others, including raccoon, opossum, and coyote. Water and marsh areas are also used by waterfowl, especially when they migrate in spring and in fall.

The Big Blue River and several of its tributaries in the Hobbs-Hall soil association are important fisheries in Seward County. Catfish fishing is fair to good in the river in Seward County, but downstream, particularly in Gage County, it is outstanding. The many small farm ponds (fig. 26) in the county, as well as those impoundments completed and stocked in northeast Seward County as part of the Oak Creek and Middle Creek Watershed Project, offer additional fishing for bass, bluegill, channel catfish, carp, and bullhead. The quality of fishing in the fishing sites in the county, however, varies widely.

Many outdoor recreational activities in the county are water oriented, and the Big Blue River offers possibilities for recreational development. Although several private recreational areas and one public recreational area are established along the river, the soils near the river are among the poorest in the county for use as building sites or for outdoor recreational activities. Poor drainage

[5] By ROBERT J. LEMAIRE, biologist, and LOYAL A. QUANDT, soil scientist, Soil Conservation Service.

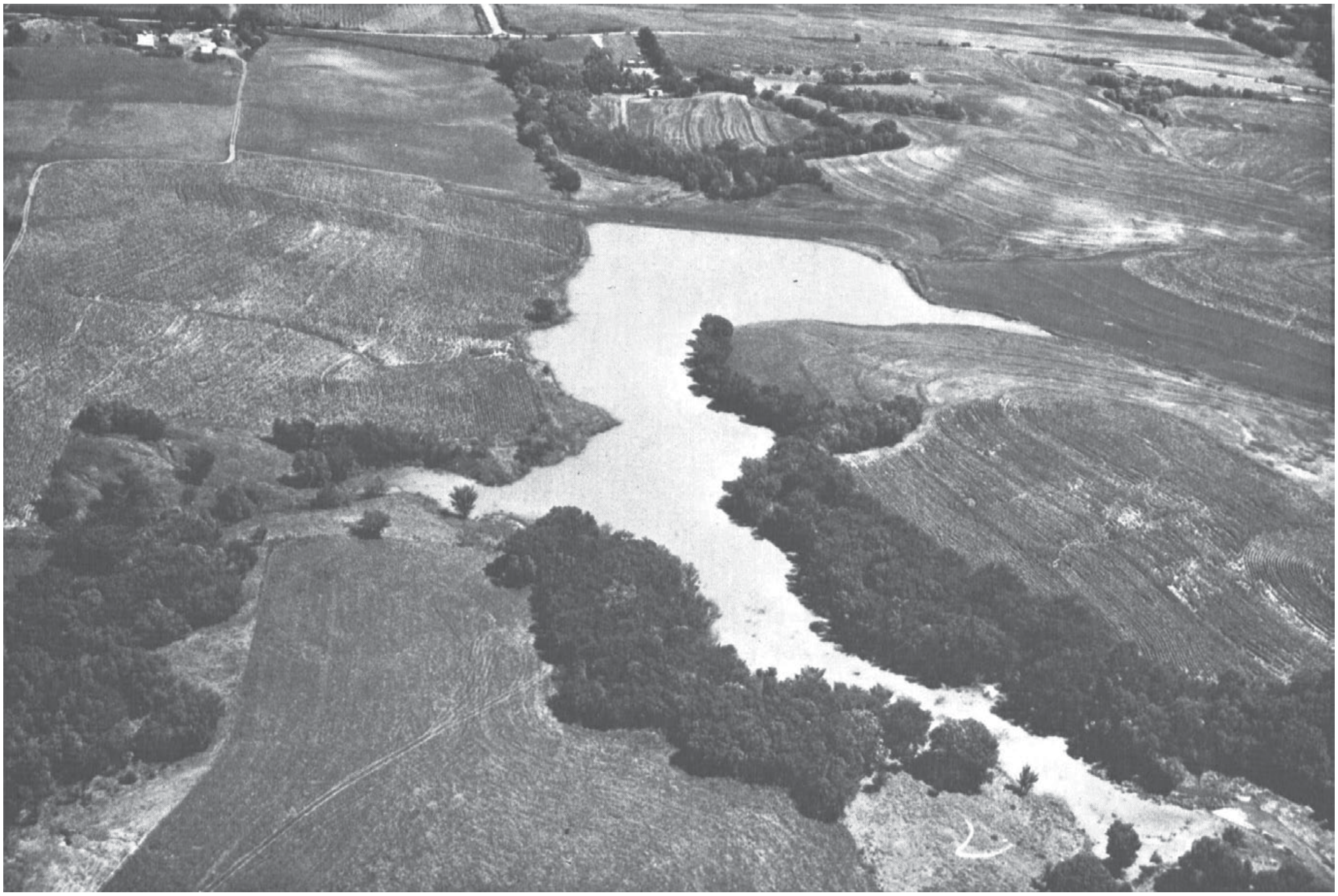

Figure 26.—**Watershed impoundment northeast of Bee, Nebraska. Soils in this area are in the Burchard, Pawnee, and Steinauer series.**

and susceptibility to flooding are among the limitations to use of these soils for recreational areas. Historic sites in various parts of the county are suitable for the development of areas for recreation.

Soils in the Hastings-Fillmore-Butler association are on uplands. They are nearly level to gently sloping. These soils are rated good for producing food in the form of grain and seed crops for wildlife. The largest pheasant population in the county is in this association. Potholes (fig. 27), important to waterfowl, also occur in this association in the western part of the county.

The soils of the Pawnee-Sharpsburg association are gently sloping to moderately sloping and are on uplands. They provide varied relief and habitat for wildlife. The many small streams and draws that dissect this association provide numerous odd areas, important for many wildlife species, with shrubby, grassy, and herbaceous vegetation that is relatively undisturbed. The stream valleys and slopes in the county that drain this association are wooded in many places, and these areas provide habitat for squirrel, bobwhite quail, cottontail rabbit, deer, and a number of other mammals and birds, including the mourning dove.

Soils in the Hastings-Wymore association are nearly level to moderately sloping. Although fewer deer and squirrel inhabit this association than the Pawnee-Sharpsburg association, the wildlife populations of these two associations are otherwise similar. Seward County has a smaller population of pheasant than some of the other counties in the central and northeastern parts of Nebraska. The greatest density of pheasant is in the western part of the county in the largest expanse of the Hastings-Fillmore-Butler soils association. Residue from grain sorghum and corn left on the ground after harvest provides an excellent supply of food for this species, and wheat and alfalfa provide nesting areas.

Soils in the Hastings-Geary association are moderately sloping to steep. They are bordered on the lower side by the nearly level soils in the Hobbs-Hall association and on the upper side by the soils in the Hastings-Fillmore-Butler soil association. This location tends to produce strips of these soils and generally precludes the occurrence of large areas. The result is many odd areas with natural grasses interspersed with cultivated tracts and woody draws. These soils produce a desirable mixture of habitat for the important game species and for many other kinds of wildlife.

The Burchard-Steinauer association generally occurs as bands that border the bottom lands of the Hobbs-

Figure 27.—**Wetland depression, or pothole, in an area of Marsh. Such areas, when they are filled with water, are valuable to waterfowl.**

Hall association. Soils in the Burchard-Steinauer association are shallow to deep and moderately sloping to steep. They provide a variety of wildlife habitat. Steinauer soils are generally steep. They are not cultivated, and most areas are covered with grasses and trees. Burchard soils are deep and moderately sloping. These soils are cultivated, and crop residue left on the ground after harvest provides food for wildlife. The cover provided by native vegetation and the food provided by seed and grain crops are important elements for increasing wildlife populations. Among important game species that populate this association are deer, bobwhite quail, pheasant, squirrel, and cottontail rabbit.

Fish ponds in Seward County are suitable only for such warm-water fish as bass, bluegill, and channel catfish. Turbidity is generally a problem in the ponds and larger streams in the county, particularly in areas where few soil conservation practices are followed and in watershed areas where the soils have a high content of clay.

Ponds on the soils in the Burchard-Steinauer association, which have a moderate to high content of lime, have less turbidity than ponds on the more clayey but less limy soils of the Sharpsburg-Pawnee association. The lime influences the aggregation of some of the minute suspended particles into larger masses, which then settle to the bottom of the pond, resulting in clearer water. Also, ponds wholly or partially supplied with water from springs are less turbid than those supplied only by surface runoff.

Table 4 shows the potential of the soil associations in Seward County for producing various kinds of vegetation to provide habitat for some of the principal game species in Seward County. It also indicates the importance of three kinds of vegetation for use as food and cover for wildlife.

Inasmuch as wildlife is produced in the county on privately owned lands used mainly for crops or livestock, the success of wildlife production depends on the use and treatment of land by farmers. Almost every practice that helps to protect and improve soil and to conserve moisture also improves food and cover for wildlife. Examples of such practices are improving grasses on rangeland and pastureland, using crop stubble, keeping grass along the edges of cropland, growing windbreaks or trees, and controlling sedimentation.

Farmers and landowners interested in wildlife can develop areas for their own use for sports or for recreational activities. Because of the increasing demand for good hunting, fishing, and recreational areas, landowners can lease their land for such purposes and thus realize economic returns. Special areas are marshes with duck blinds, water developments for fishing, upland game hunting areas, and cabin and scenic sites. Small, odd-shaped or isolated tracts occur in almost all parts of the county, and they are ideal for wildlife development, at least for the individual landowner's enjoyment. In addition, some large tracts are suitable for special areas for wildlife and recreation and can be developed as economic investments.

Technical assistance in planning wildlife areas and assistance in planning and applying conservation practices for developing outdoor recreational facilities can be obtained from the office of the Soil Conservation Service in Seward. Additional information and assistance can be obtained from the Nebraska Game and Parks Commission, Bureau of Sports, Fisheries, and Wildlife, and from the Agricultural Extension Service.

Engineering Uses of the Soils [6]

Among properties of soils highly important in engineering are particle sizes, permeability, shear strength, compressibility, compaction characteristics, and plasticity. Also important are site conditions, such as depth to the water table, depth to sand and gravel, and relief. These properties, in various degrees and combinations, affect construction and maintenance of roads, foundations for buildings, dams, and highways. The soil provides sand and gravel for road paving and surfacing, and for structural concrete. It also provides locations for storage and movement of water.

The information in this survey can be used to:

1. Make studies that will aid in selecting and developing industrial, business, residential, and recreational sites.

[6] This section was prepared by MARVIN D. KEEBLER, area engineer, and LOYAL A. QUANDT, soil scientist, Soil Conservation Service, assisted by ROBERT J. FREDRICKSON, civil engineer, Soil Conservation Service, and WILLIAM J. RAMSEY, Division of Materials and Tests, Nebraska Department of Roads.

TABLE 4.—*Potential of soil associations for producing vegetation for wildlife habitat and the importance of the vegetation for food and cover for wildlife*

[Absence of an entry means not applicable]

Soil association	Suitability for producing—				Wildlife species	Importance of vegetation for—					
	Woody plants	Herbaceous plants	Grain and seed crops	Aquatic habitat		Woody plants		Herbaceous plants		Grain and seed crops	
						Food	Cover	Food	Cover	Food	Cover
Hastings-Fillmore-Butler.	Suited	Suited	Suited	Well suited.[1]	Bobwhite quail	Low	High	High	High	High	Low.
					Pheasant	Low	High	High	High	High	High.
					Deer	High	High	Medium	Low	High	Low.
					Waterfowl					High.[2]	
Hastings-Geary	Suited	Suited	Suited		Bobwhite quail	Low	High	High	High	High	Low.
					Pheasant	Low	High	High	High	High	High.
					Deer	High	High	Medium	Low	High	Low.
Hobbs-Hall	Well suited.	Well suited.	Well suited.		Bobwhite quail	Low	High	High	High	High	Low.
					Pheasant	Low	High	High	High	High	High.
					Deer	High	High	Medium	Low	High	Low.
Hastings-Wymore	Well suited.	Well suited.	Suited		Bobwhite quail	Low	High	High	High	High	Low.
					Pheasant	Low	High	High	High	High	High.
					Deer	High	High	Medium	Low	High	Low.
Pawnee-Sharpsburg	Suited	Suited	Suited		Bobwhite quail	Low	High	High	High	High	Low.
					Pheasant	Low	High	High	High	High	High.
					Deer	High	High	Medium	Low	High	Low.
Burchard-Steinauer	Suited	Suited	Poorly suited.		Bobwhite quail	Low	High	High	High	High	Low.
					Pheasant	Low	High	High	High	High	High.
					Deer	High	High	Medium	Low	High	Low.

[1] Pertains to the Fillmore soils in this association.

[2] For dabbling duck and geese, principally in spring and in fall.

2. Make preliminary evaluations that will aid in selecting locations for highways, airports, and underground cables.
3. Make preliminary estimates of the properties of soils in planning drainage systems, farm ponds, irrigation systems, and similar sewage and feed lot runoff disposal systems.
4. Locate sites for borrow materials for highway embankment and soil binder for use in subbase courses, base courses, and surface courses.
5. Estimate the size of drainage areas and the speed and volume of runoff in designing culverts and bridges.
6. Correlate performance of engineering structures with soil mapping units and thus develop information that can be used in designing and maintaining these structures.
7. Make detailed investigations after surface soils are located.
8. Study possible corrosion of underground structures.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, results of engineering laboratory tests on soil samples, several estimated soil properties significant to engineering, and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 5, 6, and 7; and it also can be used to make other useful maps.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Estimates generally are made to a depth of about 5 feet and interpretations do not apply to greater depths. Also, engineers should not apply specific values to the estimates for bearing capacity and traffic-supporting capacity given in this survey. Investigation of each site is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

Some of the terms used in this soil survey have special meanings known to soil scientists but not known to all engineers. Many of the terms commonly used in soil science are defined in the Glossary at the back of this survey.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*9*), used by the SCS engineers, Department of Defense, and others, and the AASHO system (*1*) adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group-index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 5; the estimated classification, without group index numbers, is given in table 6 for all soils mapped in the survey area.

Engineering test data

Table 5 contains engineering test data for several soil series in Seward County. Ten soil series and 32 soil samples were tested by the Division of Materials and Tests, Nebraska Department of Roads, according to standard AASHO procedures.

Each soil listed in table 5 was sampled at only one location, and the data given for the soil are those at that location. From one location to another, a soil may differ considerably in characteristics that affect engineering. Even where the soils are sampled at more than one location, the test data probably do not show the widest range of characteristics.

The mechanical analysis was made by a combination of the sieve and hydrometer methods. The classifications in the last two columns of table 5 are based on data obtained by mechanical analysis and on tests made to determine liquid and plastic limits.

The tests for the liquid limit and the plastic limit measure the effect of water on the consistency of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the material passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition. Some silty and sandy soils are nonplastic, that is, they do not become plastic at any moisture content.

TABLE 5.—*Engineering*

[Tests performed by the Nebraska Department of Roads in cooperation with U.S. Department of Commerce, Bureau of

Soil name and location	Parent material	Nebraska report No. S64–	Depth	Moisture-density [1]	
				Maximum dry density	Optimum moisture
			In.	*Lb. per cu. ft.*	*Pct.*
Burchard clay loam: 400 feet N. and 0.45 mile W. of E. quarter corner, sec. 23, T. 12 N., R. 4 E. (Modal).	Glacial till.	7567	0–7	100	18
		7568	18–24	101	19
		7569	29–60	108	16
Fillmore silt loam: 150 feet N. and 0.1 mile E. of SW. corner, sec. 27, T. 11 N., R. 1 E. (Modal).	Peoria loess.	7552	0–8	101	18
		7553	12–24	96	22
		7554	41–60	98	22
Geary silty clay loam: 100 feet E. and 250 feet N. of SW. corner, sec. 10, T. 11 N., R. 3 E. (Modal).	Loveland loess.	7558	0–5	101	18
		7559	14–24	102	19
		7560	40–60	107	16
Hall silt loam: 200 feet S. and 0.45 mile E. of NW. corner, sec. 26, T. 12 N., R. 2 E. (Modal).	Peoria loess.	7564	0–7	100	21
		7565	19–26	91	25
		7566	39–60	100	20
Hastings silt loam: 50 feet W. and 0.15 mile S. of NE. corner, sec. 21, T. 12 N., R. 1 E. (Modal).	Peoria loess.	7535	0–6	103	19
		7536	25–36	97	22
		7537	42–60	99	20
Hastings silty clay loam, eroded: 100 feet W. and 0.45 mile N. of SE. corner, sec. 35, T. 12 N., R. 1 E. (Combined thickness of surface layer and subsoil is thinner than modal).	Peoria loess.	7544	0–5	101	19
		7545	12–20	96	22
		7546	34–60	100	20
Hobbs silt loam: 150 feet W. and 0.25 mile N. of SE. corner, sec. 31, T. 10 N., R. 1 E. (Modal).	Old alluvium.	7561	0–7	103	18
		7562	21–29	102	17
		7563	40–60	101	18
Pawnee clay loam: 100 feet S. and 0.05 mile W. of NE. corner, sec. 23, T. 9 N., R. 4 E. (Modal).	Glacial till.	7555	0–6	98	17
		7556	12–21	92	26
		7557	39–60	107	16
Sharpsburg silty clay loam: 200 feet S. and 0.45 mile W. of NE. corner, sec. 11, T. 10 N., R. 4 E. (Modal).	Peoria loess.	7541	0–5	92	22
		7542	12–22	93	25
		7543	35–60	100	21
Steinauer clay loam: 100 feet W. and 0.1 mile N. of SE. corner, sec. 17, T. 11 N., R. 4 E. (Modal).	Glacial till.	7547	0–5	99	17
		7548	17–42	107	16
Wymore silty clay loam: 100 feet W. and 0.25 mile S. of N. quarter corner, sec. 22, T. 9 N., R. 4 E. (Modal).	Peoria loess.	7538	0–5	99	19
		7539	13–21	91	27
		7540	39–60	99	22

[1] Based on AASHO Designation T 99–47, Method A (*1*).

[2] Mechanical analyses according to AASHO Designation T 88–47 (*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-sized fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-sized fractions. The mechanical analyses used in this

test data

Public Roads (BPR), in accordance with standard 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—							
¾-in.	⅜-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO [3]	Unified [4]
------	------	100	98	93	65	58	36	21	16	39	14	A-6(8)	ML-CL.
------	100	99	98	92	72	67	55	39	31	44	22	A-7-6(13)	CL.
------	------	100	97	90	72	68	55	38	30	44	25	A-7-6(14)	CL.
------	------	------	------	100	99	80	44	17	11	27	3	A-4(8)	ML.
------	------	------	------	100	98	92	81	57	51	71	44	A-7-6(14)	CH.
------	------	------	------	------	100	93	58	37	26	45	22	A-7-6(14)	CL.
------	------	------	100	99	89	74	47	26	22	32	10	A-4(8)	ML-CL.
------	------	------	------	100	93	90	73	31	27	35	14	A-6(10)	CL.
------	------	------	------	100	90	82	50	28	25	36	17	A-6(11)	CL.
------	------	------	------	100	99	92	52	33	26	36	12	A-6(9)	ML-CL.
------	------	------	------	100	99	93	67	46	39	57	30	A-7-6(19)	CH.
------	------	------	------	100	99	90	53	34	27	39	17	A-6(11)	CL.
------	------	------	------	100	99	87	54	33	29	33	12	A-6(9)	CL.
------	------	------	------	100	99	90	62	43	37	46	24	A-7-6(15)	CL.
------	------	------	------	100	99	89	56	34	27	41	20	A-7-6(12)	CL.
------	------	------	------	100	98	89	55	33	29	34	12	A-4(9)	ML-CL.
------	------	------	------	100	99	91	62	42	38	50	30	A-7-6(18)	CL or CH.
------	------	------	------	100	99	90	58	33	26	37	16	A-6(10)	CL.
------	------	------	------	100	96	89	38	18	14	31	7	A-4(8)	ML-CL.
------	------	------	------	100	97	88	46	24	20	31	8	A-4(8)	ML-CL.
------	------	------	------	100	99	90	48	29	25	38	15	A-6(10)	ML-CL.
100	98	98	98	94	74	68	52	35	31	40	16	A-5(10)	ML-CL.
------	------	100	99	95	82	79	65	48	43	53	28	A-7-6(18)	CH.
------	------	100	99	92	73	66	58	39	32	42	24	A-7-6(14)	CL.
------	------	------	------	100	99	91	66	47	41	46	22	A-7-6(14)	CL.
------	------	------	------	100	100	89	70	48	42	52	30	A-7-6(18)	CH.
------	------	------	------	100	100	91	61	34	27	41	19	A-7-6(12)	CL.
[5] 93	91	89	87	82	58	49	32	16	11	43	17	A-7-6(8)	ML-CL.
------	------	100	99	93	73	69	58	39	28	41	21	A-7-6(12)	CL.
------	------	------	------	100	99	90	63	39	33	38	15	A-6(10)	ML-CL.
------	------	------	------	------	100	96	75	53	47	63	39	A-7-6(20)	CH.
------	------	------	------	100	99	91	59	33	24	40	17	A-6(11)	CL.

table are not suitable for use in naming textural classes for soil.

[3] Based on AASHO Designation M 145–49.

[4] SCS and BPR have agreed that all soils having plasticity indexes within two points of A-line are to be given a borderline classification, such as ML–CL.

[5] Seven percent of this soil sample is coarser than ¾ inch and smaller than 3 inches in diameter.

TABLE 6.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear in the first column of this table. Because they are variable in characteristics, Breaks-Alluvial land indicate properties are too variable to be estimated. The symbol > means more than; the symbol < means less than]

Soil series and map symbols	Depth to seasonal high water table	Depth from surface of typical profile	Classification		
			Dominant USDA texture	Unified [1]	AASHO
	Ft.	*In.*			
*Burchard: BdC, BdC2, BRD, BRD2. For the Steinauer part of units BRD and BRD2, see the Steinauer series.	>20	0–12	Clay loam	CL or ML	A–6
		12–29	Clay loam	CL	A–6 or A–7
		29–60	Clay loam	CL	A–6 or A–7
Butler: Bu, 2Bu, BT [3]. For the Slickspots part of unit BT, onsite investigation is needed.	10–20+	0–12	Silt loam	ML or CL	A–4 or A–6
		12–44	Silty clay loam, silty clay, and clay.	CH	A–7
		44–60	Silt loam	CL	A–6
Crete: Ce, CeA, 2CeA	>20	0–14	Silt loam	ML or CL	A–6
		14–39	Silty clay and silty clay loam	CH	A–7
		39–60	Silty clay loam and silt loam	CL	A–6 or A–7
Fillmore: Fm	>20	0–12	Silt loam	ML	A–4 or A–6
		12–41	Silty clay and silty clay loam	CH	A–7
		41–60	Silty clay loam	CL	A–6 or A–7
Geary: GeB2, GeC2, GeC3, GeE3	>20	0–9	Silty clay loam	CL or ML	A–4 or A–6
		9–38	Silty clay loam	CL	A–6 or A–7
		38–60	Silty clay loam	CL	A–6
Hall: Ha, HaA, HSz [3]. For the Slickspots part of unit HSz, onsite investigation is needed.	10–20	0–14	Silt loam	ML or CL	A–4 or A–6
		14–39	Silty clay loam	CH or CL	A–6 or A–7
		39–60	Silt loam	CL	A–6 or A–4
Hastings:					
Hs, HsA	>20	0–13	Silt loam and silty clay loam	ML or CL	A–6
		13–42	Silty clay loam	CL	A–6 or A–7
		42–60	Silt loam	CL or ML	A–6 or A–7
HtA2, HtB2, HtC2, HtB3, HtC3, HtD3, 2HtB2, HnA3	10–20+	0–8	Silty clay loam	ML or CL	A–6 or A–7
		8–36	Silty clay loam	CL or CH	A–7
		36–60	Silt loam	CL	A–6
Hobbs:					
2Hb, Hb, HbA, HbB	6–15	0–17	Silt loam	CL or ML	A–4, A–6, or A–7
		17–33	Silt loam	CL or ML	A–6 or A–4
		33–60	Silt loam	CL	A–6
Hc	5–10	0–15	Silty clay loam	ML or CL	A–6 or A–7
		15–30	Silty clay loam	CL	A–6 or A–7
		30–60	Silty clay loam	CL	A–6 or A–7
Hord: Hd	10–20	0–17	Silt loam	ML	A–4 or A–6
		17–37	Silt loam	ML or CL	A–6
		37–60	Silt loam	ML or CL	A–6
Lamo: Lb	2–5	0–6	Silty clay loam	CL	A–6 or A–7
		6–46	Silty clay loam	CL or CH	A–6 or A–7
		46–60	Silty clay loam	CL	A–6 or A–7

See footnotes at end of table.

significant to engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for complex (By), Marsh (M), Silty Alluvial land (Sy), and Slickspots (in units BT and HSz) were not rated in this table. Dashes in a column

Mechanical analysis					Permeability	Available water capacity [2]	Reaction	Shrink-swell potential
Percentage passing sieve—				Percentage smaller than 0.002 mm.				
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
					In./hr.	*In./in. of soil*	*pH value*	
100	95–100	90–95	60–90	27–35	0. 20–0. 63	0. 17–0. 19	6. 1–6. 5	Moderate.
95–100	95–100	90–95	70–90	27–35	0. 20–0. 63	0. 15–0. 17	6. 6–7. 8	Moderate to high.
100	95–100	85–95	70–90	27–35	0. 20–0. 63	0. 14–0. 16	7. 9–8. 4	Moderate to high.
----------	----------	100	85–100	18–27	0. 63–2. 00	0. 22–0. 24	5. 6–6. 0	Low to moderate.
----------	----------	100	95–100	40–50	0. 06–0. 20	0. 11–0. 13	6. 1–7. 3	High.
----------	----------	100	90–100	18–27	0. 63–2. 00	0. 20–0. 22	7. 4–7. 8	Moderate.
----------	----------	100	90–100	18–27	0. 63–2. 00	0. 22–0. 24	5. 6–6. 0	Moderate.
----------	----------	100	95–100	40–45	0. 06–0. 63	0. 12–0. 16	6. 1–7. 3	High.
----------	----------	100	90–100	27–35	0. 20–0. 63	0. 18–0. 20	7. 4–7. 8	Moderate.
----------	----------	95–100	85–100	18–27	0. 63–2. 00	0. 22–0. 24	5. 6–6. 0	Low to moderate.
----------	----------	100	95–100	45–55	0. 06–0. 20	0. 09–0. 13	6. 1–6. 5	High.
----------	----------	100	90–100	25–35	0. 20–0. 63	0. 18–0. 20	7. 4–7. 8	Moderate.
----------	100	95–100	85–100	27–35	0. 20–0. 63	0. 21–0. 23	6. 1–6. 5	Moderate to high.
----------	100	95–100	90–100	30–35	0. 20–0. 63	0. 18–0. 20	6. 6–7. 3	Moderate to high.
----------	100	95–100	85–100	27–35	0. 20–0. 63	0. 18–0. 20	6. 6–7. 3	Moderate to high.
----------	----------	100	85–100	18–27	0. 63–2. 00	0. 22–0. 24	6. 1–6. 5	Moderate.
----------	----------	100	95–100	35–40	0. 20–0. 63	0. 18–0. 20	6. 6–7. 3	High.
----------	----------	100	90–100	18–27	0. 63–2. 00	0. 20–0. 22	7. 4–8. 4	Moderate.
----------	----------	100	95–100	18–30	0. 63–2. 00	0. 22–0. 24	5. 6–6. 0	Moderate.
----------	----------	100	95–100	35–40	0. 20–0. 63	0. 18–0. 20	6. 1–7. 3	Moderate to high.
----------	----------	100	95–100	18–27	0. 63–2. 00	0. 20–0. 22	7. 4–7. 8	Moderate.
----------	----------	100	90–100	27–35	0. 20–0. 63	0. 21–0. 23	6. 1–7. 3	Moderate.
----------	----------	100	85–100	35–40	0. 20–0. 63	0. 18–0. 20	6. 6–7. 3	Moderate to high.
----------	----------	100	85–100	18–27	0. 63–2. 00	0. 18–0. 21	7. 4–7. 8	Moderate.
----------	----------	100	95–100	12–27	0. 63–2. 00	0. 22–0. 24	5. 6–6. 0	Low.
----------	----------	100	95–100	15–35	0. 63–2. 00	0. 18–0. 22	6. 1–6. 5	Low to moderate.
----------	----------	100	95–100	25–40	0. 63–2. 00	0. 18–0. 20	6. 6–7. 3	Moderate to high.
----------	100	100	95–100	30–35	0. 63–2. 00	0. 21–0. 23	6. 1–6. 5	Moderate.
----------	100	100	95–100	35–40	0. 63–2. 00	0. 18–0. 20	6. 6–7. 3	Moderate.
----------	100	100	95–100	30–35	0. 63–2. 00	0. 18–0. 20	6. 6–7. 8	Moderate.
----------	----------	100	85–100	18–27	0. 63–2. 00	0. 22–0. 24	5. 6–6. 0	Moderate.
----------	----------	100	95–100	18–27	0. 63–2. 00	0. 20–0. 22	6. 1–6. 5	Moderate.
----------	----------	100	95–100	18–27	0. 63–2. 00	0. 20–0. 22	6. 6–7. 3	Moderate.
----------	----------	100	90–100	27–35	0. 20–0. 63	0. 21–0. 23	6. 6–7. 8	Moderate to high.
----------	----------	100	95–100	35–45	0. 20–0. 63	0. 13–0. 18	7. 4–8. 4	Moderate to high.
----------	----------	100	95–100	35–45	0. 20–0. 63	0. 18–0. 20	7. 9–8. 4	Moderate to high.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface of typical profile	Classification		
			Dominant USDA texture	Unified [1]	AASHO
	Ft.	*In.*			
Longford: LonC2	>20	0–12	Silty clay loam	CL	A-6 or A-7
		12–40	Silty clay and silty clay loam	CH	A-7
		40–60	Silty clay loam	CL or CH	A-6 or A-7
Meadin: MlD2	10–20+	0–12	Loam	SM	A-4
		12–28	Sandy loam to loamy sand	SM	A-2
		28–60	Fine sand to sand and gravel	SP-SM or SM	A-3 or A-2
Morrill: MrC2	>20	0–11	Clay loam	CL	A-6 or A-7
		11–38	Clay loam	CL	A-7
		38–60	Sandy clay loam to sandy loam.	CL or SM	A-6 to A-2
Pawnee: PwB, PwB2, PwD, PwD2, PaB3, PaC3.	>20	0–10	Clay loam	CL or CH	A-6 or A-7
		10–30	Clay	CH	A-7
		30–60	Clay loam	CL or CH	A-7
Rough broken land, loess: RB	>20				
Rough broken land, till: RBg	>20				
Scott: Sc	>20	0–7	Silt loam	ML or CL	A-6
		7–26	Clay and silty clay	CH	A-7
		26–60	Silty clay loam	CL	A-6 or A-7
Sharpsburg: ShB2, ShB3, ShD2, ShD3, ShE3.	>20	0–8	Silty clay loam	CL	A-6 or A-7
		8–35	Silty clay loam	CH	A-6 or A-7
		35–60	Silt loam	CL	A-6 or A-7
Shelby: SkC2, SkC	>20	0–10	Clay loam	CL or ML-CL	A-6
		10–35	Clay loam	CL or CH	A-6 or A-7
		35–60	Clay loam	CL or CH	A-6 or A-7
Steinauer: StC2, StE, StE2	>20	0–6	Clay loam	CL or ML	A-6 or A-7
		6–60	Clay loam	CL	A-6 or A-7
Wet alluvial land: Wx	>20				
Wymore: Wt, WtA, WtB2, WyC2	>20	0–10	Silty clay loam	CL or ML	A-6 or A-7
		10–39	Silty clay and silty clay loam	CH	A-7
		39–60	Silt loam	CL	A-6 or A-7

[1] When two or more classifications are shown, the first classification is considered the most common. Some soils that have a plasticity index within two points of a textural separate group are given a borderline classification, such as ML–CL.

[2] The figures for available water capacity are averages based on the water retention differences as determined by laboratory tests that are continuing. Present evidence indicates that the readily available water capacity of fine-textured soils may be slightly lower than that given, and that of moderately coarse textured and coarse textured soils may be slightly higher.

significant to engineering—Continued

Mechanical analysis					Permeability	Available water capacity [2]	Reaction	Shrink-swell potential
Percentage passing sieve—				Percentage smaller than 0.002 mm.				
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)					
					In./hr.	*In./in. of soil*	*pH value*	
----------	100	95–100	90–100	27–35	0. 20–0. 63	0. 21–0. 23	5. 6–6. 0	Moderate.
----------	----------	100	95–100	40–45	0. 06–0. 20	0. 11–0. 13	6. 1–7. 3	High.
----------	----------	100	95–100	27–35	0. 20–0. 63	0. 18. 0. 20	7. 4–7. 8	Moderate to high.
----------	100	85–100	35–50	15–25	0. 63–2. 00	0. 20–0. 22	5. 6–6. 0	Low.
100	85–100	35–85	15–35	10–18	2. 00–20. 0	0. 09–0. 14	6. 1–6. 5	Low.
95–100	60–90	20–60	5–20	5–10	6. 30–20+	0. 03–0. 07	6. 1–6. 5	Low to none.
----------	100	85–100	60–100	27–35	0. 20–0. 63	0. 17–0. 19	5. 6–6. 0	Moderate.
----------	100	80–100	75–100	27–35	0. 20–0. 63	0. 15–0. 19	6. 1–6. 5	Moderate to high
95–100	75–100	65–90	15–60	18–35	0. 20–6. 30	0. 12–0. 17	6. 6–7. 3	Low to moderate.
95–100	95–100	90–100	70–100	27–35	0. 20–0. 63	0. 17–0. 19	6. 1–6. 5	Moderate to high.
100	95–100	90–100	80–100	40–50	0. 06–0. 20	0. 10–0. 13	6. 6–7. 3	High.
100	95–100	90–100	70–100	32–40	0. 20–0. 63	0. 14–0. 16	7. 4–8. 4	Moderate to high.
----------	----------	----------	----------	----------	----------	----------	----------	
----------	----------	----------	----------	----------	----------	----------	----------	
----------	----------	100	90–100	20–27	0. 63–2. 00	0. 22–0. 24	5. 6–6. 0	Low to moderate.
----------	----------	100	95–100	40–50	<0. 06	0. 09–0. 11	6. 1–6. 5	High.
----------	----------	100	95–100	35–40	0. 20–0. 63	0. 18–0. 20	6. 6–7. 3	Moderate.
----------	----------	100	95–100	30–40	0. 20–0. 63	0. 21–0. 23	5. 6–6. 0	Moderate.
----------	----------	100	95–100	30–42	0. 20–0. 63	0. 18–0. 20	6. 1–6. 5	Moderate to high.
----------	----------	100	95–100	25–35	0. 20–2. 00	0. 18–0. 21	6. 6–7. 8	Moderate.
100	85–100	70–100	65–95	27–35	0. 20–0. 63	0. 17–0. 19	6. 1–6. 5	Moderate.
----------	100	90–100	75–100	27–35	0. 20–0. 63	0. 15–0. 17	6. 6–7. 3	Moderate to high.
----------	100	90–100	75–100	27–35	0. 20–0. 63	0. 14–0. 16	7. 4–8. 4	Moderate.
85–100	85–90	75–90	55–90	27–35	0. 20–0. 63	0. 17–0. 19	7. 4–8. 4	Moderate.
100	95–100	85–100	70–100	27–35	0. 20–0. 63	0. 14–0. 16	7. 9–8. 4	Moderate.
----------	----------	----------	----------	----------	----------	----------	----------	----------
----------	----------	100	95–100	27–35	0. 20–0. 63	0. 21–0. 23	5. 5–6. 0	Moderate.
----------	----------	100	95–100	40–50	0. 06–0. 20	0. 11–0. 13	6. 1–7. 3	High.
----------	----------	100	95–100	27–35	0. 20–2. 00	0. 18–0. 21	7. 4–7. 8	Moderate or high.

[3] The Slickspots part of Bulter-Slickspots complex and Hall-Slickspots complex, 1 to 3 percent slopes, has a saline condition of 2.0 to 4.0 millimhos per centimeter. Areas shown on soil maps with a slickspot symbol have similar saline conditions.

TABLE 7.—*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. The soils for other series that appear in the first column of this table. Because they are variable in characteristics, Breaks-Alluvial land complex HSz), and Wet alluvial land (Wx) were not rated in this table]

Soil series and map symbols	Suitability as source of—				Soil features affecting—		
	Topsoil	Road subgrade		Road fill	Highway locations	Foundations	Dikes and levees
		Paved	Gravel				
*Burchard: BdC, BdC2, BRD, BRD2. For the Steinauer part of units BRD and BRD2, see the Steinauer series.	Fair: moderately thick surface layer.	Poor	Good	Poor to fair with adequate moisture and compaction control; high shrink-swell potential.	Moderate to high susceptibility to frost action; slopes erodible.	Fair to poor bearing capacity; high shrink-swell potential.	Slopes erodible; cracks when dry in places.
Butler: Bu, 2Bu, BT. For the Slickspots part of unit BT, onsite investigation is needed.	Fair: moderately thick surface layer.	Fair to poor.	Good	Fair to poor: high shrink-swell potential.	High susceptibility to frost action; surface ponding may require minimum fills; slopes erodible.	Fair to poor bearing capacity; subject to ponding; high shrink-swell potential.	Slopes erodible; cracks when dry in places.
Crete: Ce, CeA, 2CeA.	Good to fair	Poor	Good	Poor: high shrink-swell potential.	Moderate to high susceptibility to frost action; slopes erodible; plastic subsoil.	Good to poor bearing capacity, depending on density; high shrink-swell potential.	Slopes erodible; cracks when dry in places.
Fillmore: Fm	Fair: modately thick surface layer.	Fair to poor.	Good	Fair to poor: high shrink-swell potential.	Slopes erodible; high susceptibility to frost heave; surface ponding may require minimum fills.	Good to poor bearing capacity, depending on moisture and density; high shrink-swell potential.	Slopes erodible; cracks when dry in places.
Geary: GeB2, GeC2, GeC3, GeE3.	Fair: moderately thick surface layer; silty clay loam.	Fair to poor.	Good	Fair to poor: high shrink-swell potential.	High susceptibility to frost action; slopes easily erodible.	Good to poor bearing capacity, depending on density; high shrink-swell potential.	Slopes erodible; cracks when dry in places.
Hall: Ha, HaA, HSz. For the Slickspots part of unit HSz, onsite investigation is needed.	Good	Fair to poor.	Good	Fair to poor: high shrink-swell potential.	Slopes erodible; occasional overflow may require minimum fills; high susceptibility to frost action.	Bearing capacity depends on density; high shrink-swell potential.	Slopes erodible; cracks when dry in places.

See footnotes at end of table.

interpretations of the soils

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions (By), Marsh (M), Rough broken land, loess (RB), Rough broken land, till (RBg), Silty alluvial land (Sy), Slickspots (in units BT and

Soil features affecting—Continued						Soil limitations for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways		
Reservoir area	Embankment					Septic tank filter fields	Sewage lagoons
Low seepage	Good to fair stability and workability; impervious; medium to high compressibility.	Generally well drained.	(1)	Slopes erodible.	Highly erodible when subsoil is exposed; droughty; maintenance may be costly.	Severe: moderately slow permeability; slopes.	Severe: slopes.
Low seepage; can be used as excavated ponds.	Good to fair stability; impervious; fair to poor workability; medium to high compressibility.	Subject to occasional ponding; poor internal drainage; adequate outlets not available in places.	Moderate to high available water capacity; moderate surface intake rate; adequate drainage needed.	Diversion slopes erodible.[2]	Generally satisfactory.	Severe: slow permeability.	Severe: moderate permeability below a depth of 3.5 feet.
Low seepage; can be used for excavated ponds.	Fair to good stability; impervious; fair to poor workability; moderate to high compressibility.	Moderately well drained; fair internal drainage; runoff is slow to medium.	High available water capacity; moderate surface intake rate.	Moderately erodible.	Moderately erodible; subsoil low in fertility.	Severe: slow permeability.	Slight.
Low seepage; can be used for excavated ponds.	Good to poor stability and workability; impervious; medium to high compressibility.	Somewhat poorly drained; poor internal drainage especially in subsoil; subject to ponding; outlets not available in places.	High available water capacity; moderate surface intake rate; adequate drainage needed.	Diversion slopes erodible.[2]	Slopes erodible.	Severe: slow permeability; ponding.	Severe: protect from ponding water; slight if dikes are above ponded surface.
Low seepage	Fair to good stability and workability; impervious; medium to high compressibility.	Generally well drained; medium to rapid surface runoff.	High available water capacity; erodible on steep slopes.	Irregular slopes make alignment difficult; erodible.	Erodibile; maintenance costs high in places; low fertility in subsoil.	Severe: moderately slow permeability; slopes.	Moderate to severe: slopes.
Low seepage in top 3 feet.	Fair stability; close control needed; fair to good workability; medium compressibility.	Generally well drained; protection needed from occasional overflow in some areas.	High available water capacity; provide protection against flooding.	Diversion slopes erodible.	Slightly erodible.	Severe: moderately slow permeability.	Severe: moderate permeability below a depth of 3 feet.

TABLE 7.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting—		
	Topsoil	Road subgrade		Road fill	Highway locations	Foundations	Dikes and levees
		Paved	Gravel				
Hastings: Hs, HsA, HtA2, HtB2, HtC2, HtB3, HtC3, HtD3, 2HtB2, HnA3.	Good	Fair to poor.	Good	Fair with compaction control; high shrink-swell potential.	Slopes erodible; high susceptibility to frost action; irregular topography and stronger slopes may require deep cuts and high fills; wetting and loading may give high consolidation.	Bearing capacity depends on in-place moisture and density; high shrink-swell potential.	Slopes erodible; cracks when dry in places.
Hobbs: 2Hb, Hb, HbA, HbB, Hc.	Good	Fair	Good	Fair: high susceptibility to frost action.	Slopes erodible; possible flooding may require minimum slopes; high susceptibility to frost heave.	Bearing capacity depends on site location; subject to occasional flooding.	Slopes erodible.
Hord: Hd	Good	Fair	Good	Fair	Slopes erodible; moderate susceptibility to frost action.	Bearing capacity depends on density.	Slopes erodible.
Lamo: Lb	Fair: moderately high water table; silty clay loam.	Fair to poor.	Good	Fair to poor: high shrink-swell potential; high susceptibility to frost heave.	High susceptibility to frost action; slopes erodible; high water table may require 4- to 7-foot fills.	High water table in places; bearing capacity may be low; high shrink-swell potential.	Moderately erodible slopes; cracks when dry in places.
Longford: LonC2	Fair: moderately thick surface layer; silty clay loam.	Poor	Good	Poor to fair: high clay content.	High susceptibility to frost action; slopes erodible.	Bearing capacity depends on site; high shrink-swell potential.	Moderately erodible slopes; cracks when dry in places.

See footnotes at end of table.

of the soils—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways		
Reservoir area	Embankment					Septic tank filter fields	Sewage lagoons
Vertical seepage may be high; horizontal seepage is low.	Good stability, compaction, and workability; medium to high compressibility; impervious; slopes erodible.	Generally well drained; rapid surface drainage on stronger slopes.	High available water capacity; erodible on stronger slopes; moderate to slow surface intake rate.	Moderately erodible.	Moderately erodible.	Severe: moderately slow permeability.	Moderate to severe: slopes; moderate permeability below a depth of 3 feet.
Low to moderate seepage; can be used for excavated ponds.	Slopes erodible; good to poor stability; close control needed; fair to good workability; drainage needed in places.	Generally well drained; protection against occasional flooding needed in places.	High available water capacity; erodible slopes; protection against overflow needed; moderate surface intake rate.	Moderately erodible; protect from flooding.	Moderately erodible.	Moderate: moderate permeability. Severe for unit 2Hb: flooding.	Severe: moderate permeability; slopes; subject to flooding.
Moderate seepage.	Slopes erodible; fair to good stability; close control needed; generally good workability; drainage needed in places; medium compressibility.	Generally well drained.	High available water capacity; moderate surface intake rate.	Slopes erodible.	Slopes erodible.	Moderate: moderate permeability.	Moderate: moderate permeability.
Low seepage; can be used for excavated ponds.	Fair to poor stability and workability; moderate to high compressibility; borrow areas wet in places.	Seasonal high water table; poor surface and internal drainage; adequate outlets not available in places.	High available water capacity; slow surface intake rate; adequate drainage needed.	Diversion slopes erodible; seasonal high water table.[2]	Moderately erodible slopes; water-tolerant grasses needed in places.	Severe: seasonal high water table.	Moderate to severe: seasonal high water table.
Low seepage	Fair to good stability; impervious; fair to poor workability; medium to high compressibility.	Generally well drained.	(1)	Moderately erodible slopes.	Erodible slopes; fertility in subsoil.	Severe: slow permeability.	Moderate to severe: slopes.

TABLE 7.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting—		
	Topsoil	Road subgrade		Road fill	Highway locations	Foundations	Dikes and levees
		Paved	Gravel				
Meadin: MID2	Fair to poor: moderately thick surface layer.	Fair to good.	Fair to poor.	Fair to good	Frost heave dependent on gradation of fill used; slopes highly erodible; loose sand may hinder loading.	Good bearing capacity if confined.	Slopes erodible; subject to seepage.
Morrill: MrC2	Fair: moderately thick surface layer; clay loam.	Poor to fair.	Good to fair.	Fair to poor for surface layer; good below a depth of 3 feet.	Slopes erodible; high susceptibility to frost action.	Bearing capacity depends on depth of footing and in-place density of soils.	Slopes erodible.
Pawnee: PwB, PwB2, PwD, PwD2, PaB3, PaC3.	Fair to poor: low fertility below a depth of 1 foot; clay loam.	Poor	Good	Poor: high shrink-swell potential and frost heave.	Moderate to high susceptibility to frost action; slopes very erodible; plastic.	Fair to poor bearing capacity, depending on in-place moisture; high shrink-swell potential.	Slopes erodible; cracks when dry in places.
Scott: Sc	Poor: thin surface layer; wet in places from ponding.	Poor	Good	Poor: high shrink-swell potential.	High susceptibility to frost action; surface ponding needs minimum fills; slopes erodible; poor workabilty; needs compaction control.	Fair to poor bearing capacity; high compressibility; subject to ponding.	Slopes very erodible; cracks when dry in places.
Sharpsburg: ShB2, ShB3, ShD2, ShD3, ShE3.	Fair: moderately thick surface layer; high clay content in subsoil; silty clay loam surface layer.	Fair to poor.	Good	Fair to poor: high: shrink-swell potential: high clay content to a depth of 3 feet.	High susceptibility to frost action; slopes erodible: steep slopes need high cuts and fill in places.	Bearing capacity depends on density and moisture on the site.	Erodible slopes; cracks when dry in places.

See footnotes at end of table.

of the soils—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways		
Reservoir area	Embankment					Septic tank filter fields	Sewage lagoons
High seepage.	Slopes erodible; subject to seepage; fair to good compaction characteristics and stability; pervious.	Excessively drained.	([1])	Slopes erodible; construction and maintenance costs may be high.	Slopes erodible; fertility low in places; maintenance costs may be high.	Severe: slopes.[3]	Severe: rapid permeability; embankments subject to seepage; slopes.
Low to moderate seepage for top 3 feet of soil.	Fair stability; fair workability; slopes moderately erodible; moderate compressibility.	Generally well drained.	([1])	Slopes moderately erodible for top 3 feet of soil; cuts may expose sandy soil.	Moderately erodible for cuts less than 3 feet in depth.	Severe: moderately slow permeability in upper 3 feet of soil; slopes; check permeability for trench greater than 3 feet in depth.	Severe: slopes; moderate permeability below a depth of 3 feet.
Low seepage.	Fair stability; cracks when dry; slopes very erodible; poor workability; impervious.	Excessive surface drainage; poor internal drainage.	([1])	Slopes erodible; construction and maintenance costs may be high; low fertility in cuts.	Slopes erodible; low fertility; construction and maintenance costs may be high.	Severe: slow permeability; slopes.	Moderate to severe slopes; may need sealing or lining to maintain depth of water.
Low seepage; can be used for excavated ponds.	Good to fair stability; impervious; poor to fair workability; erodible slopes; moderate compressibility.	Poorly drained; ponded; adequate outlets not available at reasonable cost in places.	Moderate available water capacity; moderate surface intake rate; adequate drainage must be provided.	Diversion slopes erodible.[2]	Lacks slope for economical development.	Severe: slow permeability.	Severe: subject to ponding; slight if dikes are above ponding water surface.
Low seepage in top 3 feet.	Fair stability; impervious; fair to good workability; erodible slopes; moderate compressibility.	Generally well drained.	High available water capacity; slow surface intake rate; slopes.	Erodible slopes; construction and maintenance costs may be high.	Erodible slopes; construction and maintenance costs may be high.	Severe: moderately slow permeability to a depth of 3 feet.	Moderate to severe: slopes; moderately slow to moderate permeability below a depth of 3 feet.

TABLE 7.—*Engineering interpretations*

Soil series and map symbols	Suitability as source of—				Soil features affecting—		
	Topsoil	Road subgrade		Road fill	Highway locations	Foundations	Dikes and leeves
		Paved	Gravel				
Shelby: SkC2, SkC	Fair: moderately thick surface layer.	Fair to poor.	Good	Fair to poor: high clay content; moisture control needed in places.	Moderate to high susceptibility to frost action; erodible slopes.	Fair to poor bearing capacity depends on density.	Erodible slopes; cracks when dry in places.
Steinauer: StC2, StE, StE2.	Poor: thin surface layer; low fertility; clay loam.	Poor	Good	Fair: adequate compaction control needed.	Moderate susceptibility to frost action; erodible slopes; steep slopes need high cuts and fill in places; fair workability.	Bearing capacity depends on density and moisture on site.	Erodible slopes.
Wymore: Wt, WtA, WtB2, WyC2.	Fair: moderately thick surface layer; silty clay loam.	Poor	Good	Fair: adequate compaction control needed; high shrink-swell potential.	High susceptibility to frost action; slopes erodible; fair workability.	Fair to good bearing capacity depends on density and moisture on site; high shrink-swell potential.	Erodible slopes; cracks when dry in places.

[1] Because of slope, soil characteristics, or lack of available water, these soils are generally not irrigated.
[2] Terraces generally not suitable on these soils.

Soil properties significant to engineering

Several estimated soil properties significant to engineering are given in table 6. These estimates are made for representative soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other countries. Following are explanations of some of the columns in table 6.

Depth to bedrock is not given in table 6, because bedrock is generally at too great a depth to be useful.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 6 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material 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 added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

Permeability is the rate at which water moves through a saturated soil. It is estimated on the basis of those characteristics observed in the field, particularly gradation, structure, and density. The estimates given in table 6 are given for the major significant soil horizons. Terms used to describe permeability are explained in the Glossary.

Available water capacity, expressed in inches of water per inch of soil depth, is the capacity of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in a soil at field capacity and the amount at the wilting point.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary. Soils that have a pH value of less than 6.3 and those that have one greater than 7.0 need to be investigated for potential corrosive hazard to metal structures. Soils that are used for construction material, when moist or wet, need to be tested for their corrosive potential. Salinity refers to the amount of soluble salts in the soil, and in Seward County

of the soils—Continued

Soil features affecting—Continued						Soil limitations for sewage disposal	
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways		
Reservoir area	Embankment					Septic tank filter fields	Sewage lagoons
Low seepage	Fair stability; impervious; fair to good workability; moderate compressibility.	Generally well drained; fair to good internal drainage; runoff rapid.	High available water capacity; slow surface intake rate; erodible slopes.	Erodible slopes; construction costs may be high on steeper slopes; low fertility in cuts.	Erodible slopes; fertility can be low; construction and maintenance costs may be high.	Severe: moderately slow permeability.	Severe: slopes.
Low seepage	Fair to good stability; impervious; fair workability; erodible slopes; moderate compressibility.	Somewhat excessively drained.	(1)	Erodible slopes; construction costs may be high; low fertility.	Difficult to vegetate; construction and maintenance costs may be high; erodible slopes; low fertility.	Severe: moderately slow permeability; slopes.	Severe: slopes.
Low seepage	Fair to good stability; impervious; fair to poor workability; moderate to high compressibility.	Generally well drained to moderately well drained.	High available water capacity; slow surface intake rate; erodible on steeper slopes.	Moderately to highly erodible slopes.	Moderately to highly erodible; low fertility in subsoil.	Severe: slow permeability to a depth of 3.5 feet.	Severe: moderate permeability below a depth of 3.5 feet; slopes.

[3] Because of rapidly permeable materials in the substratum, raw sewage can be introduced directly into the underground water supply.

salinity is generally not a concern. Some of the soils of the wet bottom land along the Blue River, however, are saline. Soil dispersion is not a serious concern because only a few areas contain enough salts to produce moderate dispersion. Onsite investigations are needed in areas where salinity is a hazard to construction work.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking or swelling is influenced by the amount and kind of clay in the soil. Ratings for shrink-swell potential are in table 6. Several soils, such as those of the Butler, Crete, Fillmore, Longford, Pawnee, and Wymore series, have high shrink-swell potential. Generally, soils that have a high content of clay change in volume when soil moisture is changed, but clean sands and gravel change little or not at all when wetting or drying occurs.

Engineering interpretations of the soils

In table 7 the soils are rated as sources of topsoil and as material for road subgrade and fill. Soil features are named that affect highway location, foundations, dikes and levees, reservoirs and embankments, drainage systems, irrigation systems, terraces, and waterways. Also listed are soil limitations for sewage disposal systems.

The soils in table 7 are rated *good*, *fair*, and *poor* as a source of topsoil. Topsoil is used to topdress roadbanks and dam embankments, on excavated slopes, and in gardens and lawns. Ratings are based on depth available, fertility, content of organic matter, erodibility, and workability of the soils.

The depth to sand, gravel, or rock is not given in table 7 since these materials generally are not available or are at too great a depth to be useful. Morrill soils contain mixed sand and gravel at a depth of 3 to 10 feet. Meadin soils contain sand and gravel at a depth of 10 to 20 inches and contain 5 to 20 percent fines. Outcrops of limestone and sandstone occur in some of the Steinauer soils in the eastern part of the county.

Ratings in table 7 are listed for the suitability of the soils as road subgrade for paved roads, either bituminous or concrete, and for gravel roads. Sand and gravel are rated *good* to *fair* for subgrades under pavement. For paved roads, the soil material is rated *good* if the AASHO classification is A–1 or A–3, *good* to *fair* if A–2, *fair* to *poor* if A–4, and *poor* if A–6 or A–7.

The ratings of the soils as subgrade for gravel roads refer to that part of the subgrade that receives the gravel surfacing. Sand is not cohesive, and, unless confined, it does not make good subgrade for gravel roads. Therefore, all soils classified A–1 or A–3 are rated *poor*; A–2, *poor* to *fair*; A–4, *good* to *fair*; and A–6 or A–7, *good*.

The ratings for road fill are based on about the same criteria as the ratings for road subgrade. Some ratings for paved and gravel roads and for road fill are given as a range because the soil in the profile varies.

Susceptibility to frost action is one of the factors that affect highway location. Frost action is caused by the expansion of freezing water in silty and clayey soils, and it increases maintenance needed on paved roads. Other features affecting highway location are shrink-swell potential, erodibility of cut and fill slopes, and location of the water table. A high water table can cause potential frost action. Ratings are *good*, *fair*, and *poor* for road subgrade.

Soil properties that affect foundations are bearing capacity, high water table, and shrink-swell potential. Most of the soils in the county have a high bearing capacity when dry, but some of the windblown soils are highly susceptible to consolidation when saturated under a load. Sands and gravel have a high bearing capacity when confined. Engineers should not apply numerical values to the interpretations of bearing capacity. Drainage or lowering the water table at the site of the foundation may be needed. All soils that have a high water table should be investigated thoroughly before structures are built on them.

Dikes and levees are used to control surface water. They require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, sheer strength, and compactibility. They are subject to water erosion and soil blowing, and they are subject to horizontal seepage if not properly compacted or if constructed of clean sands. Some soils are subject to shrinkage and cracking upon drying. If the dikes and levees are constructed on sandy soils, flat slopes are needed for stability. If they are built on steeper soils, clayey soil should be used because the fill is relatively impervious to water.

Features are given for farm ponds that affect reservoirs and embankments. Pond reservoir areas hold water behind a dam or embankment. Potential seepage is an important feature in constructing reservoirs. A high water table indicates a possibility for excavating a dugout for a water supply. A low, or deep, water table indicates the need for sealing or lining a pond. It also indicates that constructing a fill may be easier because of a drier foundation.

Soil properties that affect embankments in table 7 are seepage and compressibility. Workability of the soils depends on hauling and compaction characteristics. Potential seepage depends on moisture, gradation, and compaction of the fill. Meadin soils in Seward County need two methods of compaction. In table 5 test results are given for maximum dry densities for particular samples. Soils that contain 15 percent or less of silt and clay particles should have compaction controlled by the relative density test. This test is the same as the use of vibratory rather than sheepsfoot rollers.

Agricultural drainage is rated in table 7 and is determined by depth to the water table, availability of drainage outlets, and permeability of the various soil layers.

The main soil properties that affect irrigation are available water capacity, permeability, the steepness of slopes, the intake rate of water, and the possible limiting depth of the leveling cut. In table 7 the interpretations for available water capacity are for the top 5 feet of soil. The available water capacity is *high* if the soil holds more than 9 inches of water to that depth; *moderate* if the soil holds 6 to 9 inches; *low* if the soil holds 3 to 6 inches; and *very low* if the soil holds less than 3 inches. The intake rate is that amount of water that enters the soil. It is affected by the permeability of the various layers that are irrigated. Intake ratings are given for some soils in table 7 under the column "Irrigation," and a permeability range is given in table 6. A *rapid* intake rate is 2 inches or more per hour; a *moderate* rate is ½ to 2 inches per hour; and a *slow* rate is less than ½ inch per hour.

Further information on the suitability of the soils for irrigation is contained in The Irrigation Guide for Nebraska (7).

The use of the soils for terraces, diversions, and grassed waterways is limited by possible water erosion and soil blowing, by difficulty in establishing vegetation, and by soil fertility. The cost of maintaining terraces and diversions is higher where siltation from higher areas takes place. Depth to erodible sands limits cut depths for diversion alignment. Other factors in aligning terraces and diversions are rough relief and steep slopes.

The degree and kinds of limitations for sewage disposal systems are shown in table 7. Other factors such as soil classification, permeability, and available water capacity, also related to sewage disposal, are in table 6. The limitations for filter fields are rated *slight*, *moderate*, or *severe*. *Slight* includes good infiltration without contaminating the underground water; *moderate* includes a finer grained soil that has a lower intake rate; and *severe* includes a high water table or an impervious soil.

For sewage lagoons, water must be retained in order for the aerobic decomposition of the fresh sewage. Thus, an impervious soil is needed. The soil may need sealing with bentonite or sodium carbonate or lining with a commercial plastic or rubber liner. A lagoon constructed on sandy material and a high water table is rated *severe* and is least desirable. A sewage filter field or disposal lagoon should be located in an area that does not contaminate wells that furnish domestic water supply or stock water. Other factors to be considered in design of sewage treatment facilities are steepness of slope and the hazard of flooding.

Formation and Classification of Soils

This section tells how the factors of soil formation have affected the development of soils in Seward County. It also explains the system of soil classification currently in use and places the soil series represented in the survey area in some of the categories of this system.

Factors of Soil Formation

Soil is formed by the physical and chemical weathering of parent material. The characteristics of the soil at any given point are determined by (1) the physical and mineral composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

The climate and the plants and animals, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil forms. It influences soil formation by its mineral composition, its physical properties that affect permeability to air and water, its ability to retain water, its resistance to movement by wind and water, and its ability to permit plant roots to penetrate. Soil formation is also influenced by chemical properties that relate to reaction, plant nutrient levels, and weathering characteristics of parent material. The geologic materials (fig. 28) exposed at the surface are the parent materials of the soils.

The parent materials of soils in Seward County are of five kinds: glacial till, Pleistocene sand and gravel, reddish-brown loess of the Loveland Formation, Peoria loess, and alluvial material. Peoria loess is the most extensive parent material. Other sources are Dakota sandstone and shale, the uppermost bedrock under the entire county (*2*, *3*), and Graneros shale and Greenhorn limestone (fig. 29). These two formations are of variable thickness and extent, are above the Dakota sandstone, and are exposed along streambanks in the eastern part of the county. Following are descriptions of each material.

Glacial till.—The eastern part of Seward County was covered by two continental glaciers (*2*, *3*). As these glaciers retreated, material consisting of clay loam till, sand, gravel, and boulders was left on the landscape. This material contains numerous pockets and segregations of white lime and many reddish-brown stains. The surface of a till-mantled landscape commonly has many stones and boulders. Soils of the Burchard, Pawnee, Shelby, and Steinauer series formed in till. Morrill soils formed in outwash material reworked from this till.

Pleistocene sand and gravel.—During Pleistocene time mixed sand and gravel was deposited, mainly in valley positions and beneath uplands (fig. 30) in the area west of the Big Blue River. Soils of the Meadin series formed in areas where sandy and gravelly materials outcrop lower down on the sides of valleys.

Reddish-brown loess of the Loveland Formation.—This loess or loesslike material was deposited over most of the county. It covers till in the eastern part and blankets sand and gravel in the western part.

The Loveland Formation in Seward County is a light reddish-brown or light-brown silt loam or silty clay loam loess or loesslike material in the upper part. In the lower part it grades to clayey alluvial material containing fine and medium sand. This loess occurs mainly as outcrops on the sloping sides of drainageways. Soils of the Geary and Longford series formed in Loveland materials. The acreage of these soils is small in this county, but in places these soils constitute an appreciable part of the landscape.

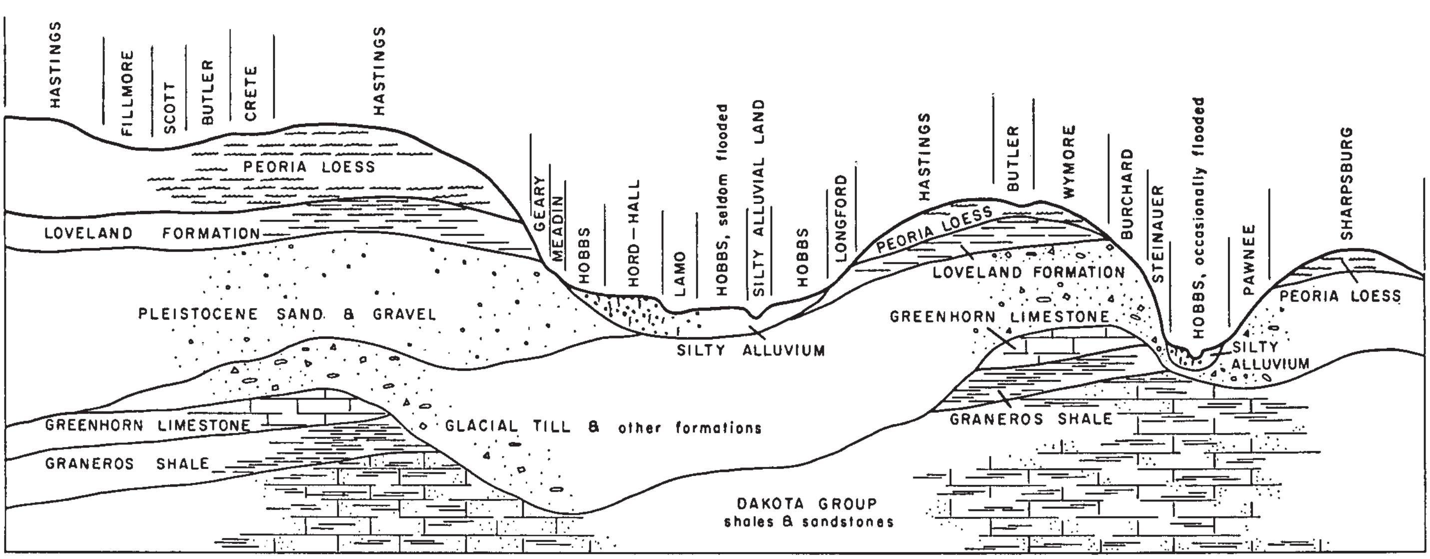

***Figure 28.*—A profile section across Seward County, west to east, showing the relationship of soils and parent materials.**

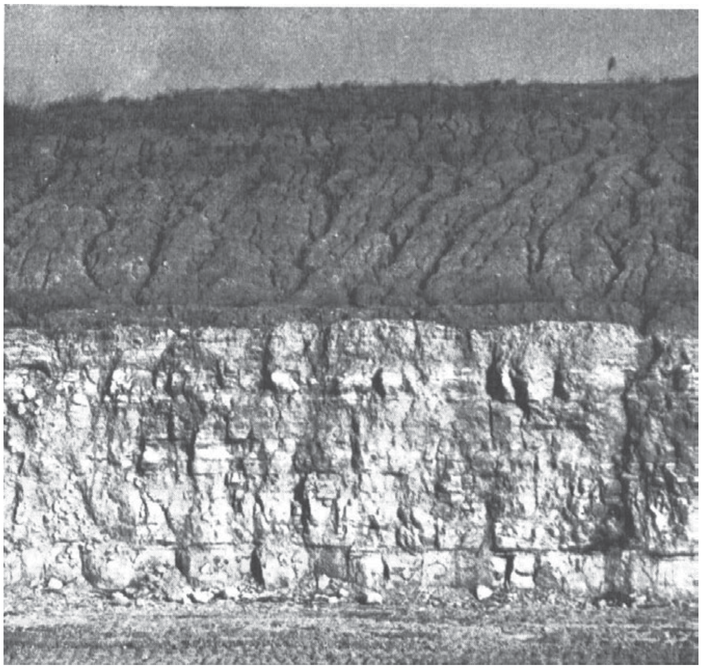

Figure 29.—Limestone quarry in northwestern Seward County. The Greenhorn limestone is overlain by till material.

Figure 30.—Profile of a Geary soil underlain by stratified layers of Pleistocene sand and gravel.

Peoria loess.—This pale-brown or light-gray silty material was deposited by wind over the Loveland Formation. In the west and central parts of the county, the Butler, Crete, Fillmore, Hastings, and Scott soils formed in Peoria loess. Soils of the Sharpsburg and Wymore series formed in Peoria loess in the eastern part of the county. Soils of the Hall and Hord series formed in loess and loesslike material of alluvial origin on stream terraces.

Alluvial material.—Alluvial sediment deposited along the rivers and creeks ranges from a few feet in thickness in small upland valleys to more than 50 feet in old channels of the major bottom lands. The sediment consists of clayey, silty, and sandy material, mixed or in strata. Alluvium is the parent material of the Hobbs and Lamo soils.

Climate

Climate is important in the formation of soils through its influence on vegetation, activity of microorganisms, weathering, and deposition of parent materials. Cool temperatures activated glaciers that left till material in the eastern part of the county. Dry and windy periods produced eolian or dust particles, which accumulated as loess deposits. Wind transfers soil material from place to place. The movement of water received as rain influences the shaping of the landscape. Alternate freezing and thawing hastens mechanical disintegration of parent material. The temperature and the amount of precipitation favor grass vegetation and moderate chemical and microbiologic activity.

Climate had an influence in fixing the present character of soils in Seward County because of somewhat long periods of weathering. Leaching has largely removed carbonates, as well as other soluble elements, to a depth below the subsoil on some landscapes. Except for some of the steeper soils, most of the soils in Seward County are medium acid to neutral in the surface layer and in the upper part of the subsoil. Although somewhat leached, these soils still retain a high percentage of basic elements.

The climate of Seward County is characterized by moderately long and cold winters, cool springs with considerable precipitation, warm summers with many thunderstorms, and mild autumns with occasional rainy periods. The climate is fairly uniform throughout the county; therefore, differences in soils cannot be attributed to differences in climate. There are wide seasonal differences in temperature as well as wide variations in the amount of rainfall. The temperature often falls below 0° F. in winter and soars to almost 100° in summer. The annual average precipitation is 27.5 inches.

Plants and animals

The soils of Seward County formed under mid and tall grasses. This kind of vegetation provides an abundant supply of organic matter that affects the physical and chemical properties of soils and the dark color of the surface layers. The fibrous roots of these grasses penetrate the soil, make it porous, and encourage development of granular structure. The plant roots take up minerals in solution from the lower parts of the soil and eventually return them to the surface soil in the form of organic matter and minerals.

The soils on sites that absorb most of the precipitation have a thicker, darker surface layer because they support a better growth of grass. Soils in depressions have much of the organic matter leached from the surface layer into the subsoil. Some soils on bottom lands have a thick, dark surface layer because they have received dark sediment that eroded from soils on the uplands.

Microorganisms are an important link in the transformation of undecomposed organic matter into humus. The action of bacteria and various kinds of fungi causes the decay of dead leaves and other organic matter. Earthworms and small burrowing animals help to mix humus with the soil. The presence of decayed organic matter gradually changes the physical and chemical composition of the surface soil.

Man's activities, particularly in altering drainage conditions, maintaining fertility, and changing the kinds of vegetation, have an immediate effect upon both the rate and the direction of soil-formation processes.

Relief

Many soil differences can be attributed to local variations in relief. Soil formation is affected by the influence relief has on drainage, runoff, erosion, and deposition. The rapid runoff on steep soils results in little water penetrating the soil, slight leaching and profile development, and thin, dark-colored surface layers. Soils in depressions, lacking drainage, receive additional water from higher adjoining soils and have a strongly leached subsurface layer and an accumulation of clay in the subsoil.

On bottom lands the lack of relief and slow surface drainage causes differences in soil reaction and in the kind and amount of vegetation growing on the soils.

In Seward County, Steinauer soils are steeply sloping, Hastings soils are gently sloping to moderately sloping, and Butler and Crete soils are nearly level.

Time

Differences in the amount of time that soil materials have been exposed to soil-forming processes is reflected in the characteristics and properties of the soil. A considerable length of time is required for the development of a mature soil that has genetic horizons. The longer parent material is exposed to weathering and soil development, the more nearly it will have a profile in equilibrium with its environment. The length of time required depends on the interaction and intensity of other soil-forming processes. Soils develop slowly in dry climates under sparse vegetation. They develop more rapidly in moist climates under dense vegetation.

Some soils in Seward County have not had time to develop definite soil horizons. Soils that are steep constantly lose soil material, and new material is exposed to weathering. Therefore, the steeply sloping Steinauer soils have minimal soil development. The Hobbs soils have weakly developed horizons because they formed in recently deposited alluvial sediment. The Butler, Hastings, Sharpsburg, and Wymore soils formed in Peoria loess; the Burchard and Pawnee soils formed in till; and the Geary and Longford soils formed in reddish-brown loess. These soils have been in place long enough for well-defined, genetically related horizons to form.

Many centuries are required for soils to become mature with genetically related horizons, but a dark-colored surface layer forms under grassland vegetation in 100 to 200 years. The till in the eastern part of the county has been weathered and leached and has had chemical and physical changes for as long as any of the parent materials. Soil development in the mature soils of Seward County has primarily occurred during the last 10,000 to 15,000 years. The more recent mantle of loess deposits has been exposed to similar soil-forming factors in developing the soil profiles as we see them today.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of classification currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature available (*5*, *8*). The soil series of Seward County are placed in some categories of the current system in table 8.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measureable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. Most of the classes of the current system are briefly defined in the following paragraphs.

ORDERS.—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. Table 8 shows that the two soil orders in Seward County are Entisols and Mollisols.

Entisols are light colored and do not have natural genetic horizons or have only very weakly expressed beginnings of such horizons. These soils do not have traits that reflect soil mixing caused by shrinking and swelling.

Mollisols formed under grass and have a thick, dark-colored surface horizon containing colloids dominated by bivalent cations. The material in these soils has not been mixed by shrinking and swelling.

SUBORDERS.—Each order has been subdivided into suborders, primarily on the basis of the characteristics that seemed to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

TABLE 8.—*Soil series classified according to the current system of classification* [1]

Series	Family	Subgroup	Order
Burchard	Fine-loamy, mixed, mesic	Udic Argiustolls	Mollisols.
Butler	Fine, montmorillonitic, mesic	Abruptic Argiaquolls	Mollisols.
Crete	Fine, montmorillonitic, mesic	Pachic Argiustolls	Mollisols.
Fillmore	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Geary	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hastings	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Lamo	Fine-silty, mixed (calcareous), mesic	Cumulic Haplaquolls	Mollisols.
Longford	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Meadin	Sandy-skeletal, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Morrill	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Pawnee	Fine, montmorillonitic, mesic	Aquic Argiudolls	Mollisols.
Scott	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Sharpsburg	Fine, montmorillonitic, mesic	Typic Argiudolls	Mollisols.
Shelby	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Steinauer	Fine-loamy, mixed (calcareous), mesic	Typic Udorthents	Entisols.
Wymore	Fine, montmorillonitic, mesic	Aquic Argiudolls	Mollisols.

[1] Placement of some soil series in the current system, particularly in families, may change as more precise information becomes available. Classification as of August 1972.

GREAT GROUPS.—Suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that contain a pan that interferes with growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 8, because it is the last word in the name of the subgroup.

SUBGROUPS.—Great groups are subdivided 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 may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILIES.—Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, minerals, reaction, soil temperature, permeability, thickness of horizons, and consistence.

General Nature of the County

This section provides information about the settlement and the population of Seward County. In addition, it discusses the physiography, relief, drainage, climate, and water supply of the county. This section also gives significant facts about the cultural features of the survey area.

Settlement, Organization, and Population

Seward County was established as Greene County on January 26, 1856, and its boundaries were defined on the same date. The first settlement was made in 1859 in the southeastern part of the county. The inhabitants settled near narrow strips of timber, where the supplies of water and fuel were abundant. They came from many of the northern and eastern states, but large numbers also immigrated from European countries, mainly Germany. The Germans settled in and around Seward and in the southeastern part of the county. Swedes and Danes settled mostly in the northern and western sections; Amish Mennonites, from the western border areas of Russia, settled in the south-central part of the county, and a large colony of Czechoslovaks immigrated to the northeastern part following political upheavals in Europe.

On January 3, 1862, a legislative act changed the name of the county from Greene to Seward in honor of William H. Seward, Secretary of State during the Lincoln administration. The early settlers endured and overcame many hardships and hazards of the open prairie and inclement weather. A few early settlers were forced to leave because of crop failures caused by damage from insects and droughts. Nevertheless, by the 1870's most of the county was homesteaded.

Between 1890 and 1960 the population of Seward County declined from 16,140 to 13,581; but in 1968 the population was estimated to be 15,586. The population of the City of Seward was 3,154 in 1950, was 4,208 in 1960, and was estimated to be 5,298 in 1968.

Two monuments in the southeastern part of Seward County mark significant historic points of interest. One in Section 32, Township 10 North, Range 4 East reads: "This monument in memory of Nebraska pioneers marks the site and establishment of the Oregon Trail Cutoff, Nebraska City to Fort Kearney, 1861; aspiring the Town of Camden, 1864; first Seward County School District, 1866." The monument in Section 19, Township 10 North, Range 4 East has the caption: "Council Oak. Tree and spring on the old Indian trail used by the Pawnee Indians, between 1870 and 1880 under which they held many councils."

Physiography, Relief, and Drainage

Seward County lies within the Great Plains area. Its relief slopes gently toward the southeast. Elevation ranges from 1,240 feet about 1½ miles northeast of Pleasant Dale in the southeastern part of the county to 1,640 feet in the northwestern part of the county.

The county has two main physiographic areas: the uplands and the bottom lands. The uplands are subdivided into the drift hills in the eastern one-fifth of the county and the loess plains that extend west of this area. The bottom lands are of two levels: the first, or low bottom lands, which are seldom to frequently flooded; and the stream terrace bottom lands, which are on slightly higher areas adjacent to the uplands.

The eastern part of the county, the drift hills, is drained by Oak and Middle Creeks. Relief is moderate. The loess plains area is drained by the Big Blue River, Lincoln Creek, Plum Creek, and Johnson Creek. Relief is slight with moderate slopes bordering the drainageways. Drainage is well developed, except on the nearly level depressional areas. Areas where natural drainage is lacking are mostly in the vicinity of Utica and Tamoras.

Alluvial bottom lands border the major river and stream channels. The low bottom lands have old channels or oxbows that flood frequently. Slightly higher, nearly level areas, which are occasionally or seldom flooded, are more extensive on the bottom lands. A few areas are wet because of a high water table or because of poor surface drainage. The nearly level areas on stream terraces are well drained.

Climate [7]

Seward County, in southeastern Nebraska, is near the center of the United States. The climate is typical of that at this latitude near the center of a large continent. The warm summers are puncuated by thundershowers followed by brief spells of cooler weather. Winters are generally cold and dry. There are great variations in temperature and rainfall from day to day and from season to esason. Most of the moisture that falls in the area originates in the Gulf of Mexico. As a rule, over three-fourths of the annual precipitation occurs from April to September, when the prevailing winds are from a southerly direction.

Precipitation early in spring is characterized by slow, steady snow or rain. Snow is common during the first part of March, but by the latter half of the month much of the precipitation falls as rain. As spring advances, more and more of the rain falls as brief showers, and by mid-May most of the precipitation is associated with thundershowers. Thunderstorms in spring and early in summer are severe at times and are likely to be accompanied by local downpours, hail, damaging winds, and an occasional tornado. The severe storms are generally local and of short duration. Damage from hail is extremely variable and occurs in a spotted pattern, but in the center of the more intense storms there may be a total loss of crops.

As indicated in table 9, more precipitation generally is received in June than in any other month. Actually, the peak is reached during the second week in June, after which time the showers gradually are lighter and farther apart. With the coming of fall, the amount of precipitation decreases, fewer thunderstorms occur, sunshine is abundant, days are mild, and nights are cool.

An average of one July in 10 has less than 0.8 inch of rain, and one July in 10 has more than 7.2 inches.

Precipitation in winter generally is light, and most of it falls as snow, although it is not unusual to have several periods of rain or freezing rain. Snow is often accompanied by strong northerly winds and low temperatures. The average annual snowfall is about 31 inches, but the amount varies greatly from year to year. Frequently, one snow melts before the next snow falls. During an average winter, snow covers the ground for only 42 days.

Data concerning the frequency of high and low temperatures is also indicated in table 9. According to this table, in 2 years in 10, the maximum temperature equals or exceeds 102° F. on at least four days in July. The average annual high temperature is 103°. In 2 years in 10, the minimum temperature in January falls to 8° below zero or lower on four nights, and the average annual minimum is 16° below zero. The extreme maximum of 114° and the extreme minimum of 30° below zero were both recorded in 1936.

The probabilities of selected temperatures occurring after specified dates in spring or before certain dates in fall are given in table 10. As indicated in this table, in 5 years in 10 the air temperature falls below 32° after April 29 (average date of last freeze), and in 1 year in 10 the last freeze is after May 14. In fall the first freeze occurs before September 27 in 1 year in 10.

Annual evaporation of fall water from shallow lakes or ponds averages about 45 inches. About 76 percent of the total evaporation occurs during the 6-month period between May and October.

Ground Water

Ground water conditions in Seward County vary greatly because the underlying geologic material in the different parts of the county determines the water-bearing properties. The area west of the Big Blue River has a more favorable underground water supply than the area east of the river (fig. 31).

Ground water is available for domestic use throughout most of the county. Much of the county west of the Big Blue River is underlain by thick deposits of sand and gravel that yield sufficient quantities of water from wells for irrigating crops.

The ground water west of the Big Blue River is of good quality for domestic use. A few artesian, or flowing,

[7] By R. E. MYERS, climatologist for Nebraska, National Weather Service, U.S. Department of Commerce.

wells are along the bottom lands of the West Fork of the Big Blue River in the general vicinity of Beaver Crossing.

Most areas east of the Big Blue River have very thin layers of underlying sand and gravel or have only loess and glacial material over bedrock. Wells generally yield enough water for domestic and livestock use, and large-volume wells for irrigation usually cannot be developed. Some water is obtained from the Dakota Formation in the vicinity of Pleasant Dale, but the large amounts of dissolved minerals make it somewhat undesirable for domestic use. It is, however, suitable for irrigation. A few springs are in the northeastern part of the county.

The ground water is at a shallow depth on bottom lands and at a moderately shallow depth on stream terraces of the Big Blue River valley. The sand and gravel beneath the valley usually do not yield sufficient water for pump irrigation.

TABLE 9.—*Temperature and precipitation, Seward County, Nebraska*

[Data from Seward, Nebraska]

Month	Temperature				Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Two years in 10 will have at least 4 days with— Maximum temperature equal to or higher than [2]—	Two years in 10 will have at least 4 days with— Minimum temperature equal to or lower than [2]—	Average monthly total [1]	One year in 10 will have— Equal to or less than [3]—	One year in 10 will have— Equal to or more than [3]—	Days with 1 inch or more snow cover [1]	Average depth of snow on days with snow cover [1]
	°F.	°F.	°F.	°F.	In.	In.	In.	No.	In.
January	34	13	54	−8	0.7	0.2	1.6	14	4
February	39	18	59	−2	1.0	.1	2.0	11	4
March	48	27	72	8	1.6	.2	3.0	7	5
April	64	40	83	26	2.5	.7	4.8	(4)	2
May	74	50	89	36	3.6	1.5	7.7	(4)	1
June	83	61	97	49	5.4	2.0	8.7	----------	----------
July	89	65	102	55	3.3	.8	7.2	----------	----------
August	87	64	100	54	3.3	1.6	6.6	----------	----------
September	78	54	96	39	2.8	1.0	5.4	----------	----------
October	69	43	85	29	1.4	.2	3.7	----------	----------
November	51	28	70	13	1.0	(5)	3.0	2	3
December	39	19	57	−3	.8	.1	1.6	8	4
Year	63	40	[6] 103	[7] −16	27.5	19.9	37.3	42	4

[1] Based on the period 1938–67.
[2] Based on the period 1921–63.
[3] Based on the period 1891–1967.
[4] Less than ½ day.
[5] Trace.
[6] Average annual highest maximum.
[7] Average annual lowest minimum.

TABLE 10.—*Probability of selected temperatures in spring and in fall, Seward County, Nebraska* [1]

[All data from Seward, Nebraska]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10, later than	April 5	April 12	April 19	May 2	May 14
2 years in 10, later than	March 30	April 7	April 14	April 27	May 9
5 years in 10, later than	March 20	March 28	April 3	April 16	April 29
Fall:					
1 year in 10, earlier than	November 1	October 23	October 16	October 7	September 27
2 years in 10, earlier than	November 6	October 28	October 21	October 12	October 2
5 years in 10, earlier than	November 17	November 7	October 31	October 22	October 11

[1] All freeze data are based on temperatures in a standard U.S. Weather Bureau thermometer shelter at a height of approximately 5 feet above the ground and in a representative exposure. Lower temperatures will exist at times nearer the ground and in local areas subject to extreme air drainage.

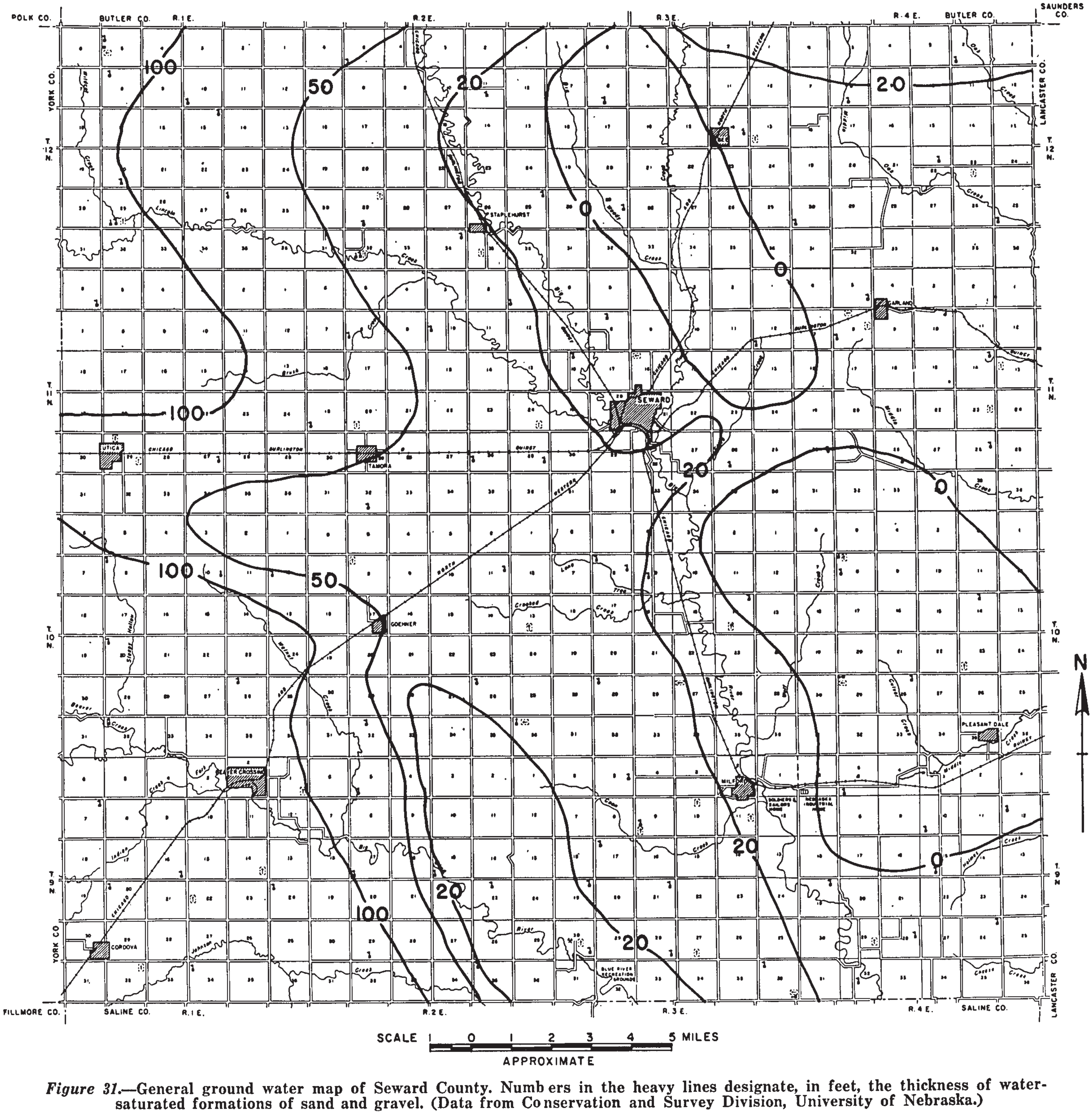

Figure 31.—General ground water map of Seward County. Numbers in the heavy lines designate, in feet, the thickness of water-saturated formations of sand and gravel. (Data from Conservation and Survey Division, University of Nebraska.)

Farming

Farming has been the main source of income in Seward County since the county was settled. Flax and barley were the first field crops grown by the settlers, but these crops were gradually replaced by wheat as a cash crop and by corn and oats as feed grains.

Completion of the first railroad in Seward County greatly stimulated farming. The newly plowed prairie soils were high in content of organic matter and in fertility, and when rainfall was adequate the response of crops was good. According to the 1910 Census, the average yield per acre of corn for the county was about 30 bushels. Other crops, such as rye, beans, sorghum, alfalfa, and clovers, subsequently became important, and most of the spring wheat was replaced by winter wheat. As means of transporting livestock to market improved, the number of livestock raised by farmers increased.

Growing crops under high levels of management and following soil and water conservation practices have helped to advance farming in Seward County. Among the recent trends are: use of new improved crop hybrids, fertilization, and irrigation; use of chemicals to control weeds and insects; use of larger, more efficient machinery; and use of improved methods of tillage.

The 1964 Census of Agriculture listed 1,399 farms in Seward County, averaging 255.8 acres per farm. There were 562 cash grain farms, 11 poultry farms, 79 dairy farms, 447 livestock farms other than poultry and dairy, one livestock ranch, 105 general farms, and 194 miscellaneous and unclassified farms. Of 357,805 total acres in farm land, only 30,970 acres of cropland, on 336 farms, was irrigated. The average size of irrigated farms in the county was 342.1 acres.

According to the 1968 Conservation Needs Inventory, 278,632 acres was in cropland, 22,141 was in pasture, 36,689 was in rangeland, and 6,014 was in woodland. Homes, lots, roads, and wasteland occupied 7,519 acres.

Corn, grain sorghum, and wheat are the principal crops. Soybeans and alfalfa are somewhat less extensively grown. The Nebraska Agriculture Statistics Annual Report listed the irrigated acreage of harvested crops in 1969 as 46,710 acres of corn, 7,490 acres of grain sorghum, 1,660 acres of soybeans, and 920 acres of alfalfa. The nonirrigated acreage of harvested crops was 25,140 acres of corn, 50,140 acres of grain sorghum, 44,280 acres of wheat, 15,860 acres of soybeans, and 14,280 acres of alfalfa.

Cattle are the principal livestock in Seward County, but hogs, sheep, and chickens are also important. The Nebraska Agricultural Statistics Annual Report listed the following numbers of livestock on farms as of January 1, 1969: 3,600 milk cows and 58,400 other cattle, 5,700 sheep, and 134,000 chickens. This report also indicated that 36,460 hogs were on farms as of December 1, 1968.

Irrigation

Irrigation has had a significant effect on farming in Seward County. Production of cash crops and feed grains has increased to such an extent that yields for irrigated crops are 50 to 150 percent above the yields for similar crops under dryland management. Changing a farm from dryland to irrigated management, however, requires a large capital investment. The incentive is a greater and more stabilized production because of less dependence on annual precipitation and a more intensive use of the present cropland.

The number of wells in the county has steadily increased since 1954. The most intensive development of wells and acreage for irrigation occurred in 1956, when 135 wells were drilled and 9,901 acres developed for irrigation. According to the 1969 Census of Agriculture, 30,970 acres was irrigated in Seward County in 1964, and 47,443 acres was irrigated in 1969. As of July 1, 1967, 458 registered irrigation wells had been reported. In addition to these wells, there were 150 permits to pump water from the major streams in the county.

Land leveling is a common practice on irrigated land throughout the county. Many areas once considered to be impractical for irrigation because of steepness of slope have been leveled and now produce excellent yields.

Transportation and Markets

The Chicago, Burlington, and Quincy Railroad and the Chicago and Northwestern Railroad cross the county and furnish rail transportation for the towns of Seward, Milford, Utica, Beaver Crossing, Goehner, Tamora, Staplehurst, Garland, and Pleasant Dale. The east-west 4-lane Interstate Highway No. 80 crosses the county 5½ miles south of Seward. State Routes No. 2 and No. 15 and Federal Highways No. 6 and No. 34 provide good, hard-surfaced roads to most towns in the county. Gravel roads are on most section lines, except along the bottom lands and on areas of rough relief. Seward and Milford have regular bus service.

Most of the corn, grain sorghum, wheat and soybeans grown in the county are taken to local grain elevators, from which the grain is transported by rail and truck to larger markets. Some of the grain is fed to livestock, which are shipped mainly to processors in Omaha and Lincoln. Much of the poultry and dairy products are marketed in the local communities, although some are shipped directly to larger markets.

Industry

The economy of Seward County depends mainly on farming and related marketing products. The operation of grain elevators is the principal small industry in the county; every town has at least one. These elevators furnish facilities for storage of grain, grinding or rolling of feed, cleaning or treating of seeds, and distribution of commercial fertilizers.

A limestone quarry is 4 miles northeast of Garland along Oak Creek. The limestone is about 80 percent calcium carbonates and is crushed lime that is used in farming and in road surfacing.

Several small industries manufacture equipment for irrigation systems, transmission lines, and machine equipment used in farming operations.

Community, Cultural, and Recreational Facilities

Seward, the largest town and county seat, is centrally located. The community supports many churches, and it has a modern hospital and medical center, a home for senior citizens, a public library, a swimming pool, parks, a golf course, and numerous service and social clubs.

Elementary schools are in all towns in Seward county. Seward, Milford, and Utica have accredited high schools. Most of the school districts operate school buses to transport elementary and high school students.

Concordia Teachers College in Seward is a 5-year teacher-preparation college and has an enrollment of 1,400. The Nebraska Vocational Technical School is in Milford.

The Big Blue River and its tributaries provide fishing, hunting, boating, and camping and picnicking sites. A few of the large depressional areas near Utica are developed for hunting migratory water fowl. Twin Lakes, which have 255 surface acres of water and several of the larger structures of the Oak-Middle Watershed, are being developed to provide facilities for swimming, water skiing, boating, fishing, camping, and picnicking.

Literature Cited

(1) American Association of State Highway Officials.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., 401 and 617 pp., illus.

(2) Condra, G. E., Reed, E. C., and Gordon, E. D.
1950. CORRELATION OF THE PLEISTOCENE DEPOSITS OF NEBRASKA. Nebr. Geol. Sur. Bul. 15A, 74 pp., illus.

(3) Reed, E. C., and Dreeszen, V. H.
1965. REVISION OF THE CLASSIFICATION OF THE PLEISTOCENE DEPOSITS OF NEBRASKA. Nebr. Geol. Sur. Bul. 23, 65 pp., illus.

(4) Richards, L. A., ed.
1954. DIAGNOSIS AND IMPROVEMENT OF SALINE AND ALKALI SOILS. U.S. Dept. Agr. Handb. 60, 160 pp., illus.

(5) Simonson, R. W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Science, v. 137, No. 3535: 1027–1034, illus.

(6) United States Department of Agriculture.
1951. SOIL SURVEY MANUAL. Agr. Handb. No. 18, 503 pp., illus.

(7) ———
1971. IRRIGATION GUIDE FOR NEBRASKA. Soil Conservation Service.

(8) ———
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM. 7th approximation. 265 pp., illus. (Supplements issued in March 1967 and 1968.)

(9) United States Department of Defense.
1968. UNIFIED SOIL CLASSIFICATION SYSTEM FOR ROADS, AIRFIELDS, EMBANKMENTS, AND FOUNDATIONS. MIL-STD-619B, 30 pp., illus.

Glossary

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.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. In this survey the classes of available water capacity for a 60-inch profile or to a limiting layer are:

Inches per inch of soil	*Class*	*Inches per inch of soil*	*Class*
0–3	Very low	6–9	Moderate
3–6	Low	More than 9	High

Bottom land. The normal flood plain of a stream, part of which may be flooded frequently.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pastures, formed by cattle tracks or slippage of saturated soil.

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.

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.

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.

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.

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.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

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.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

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:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral 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 horizons; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Hummocky. Pertains to a landscape in which there are hillocks having little or no top, steep side slopes, and low sags between the hillocks. Rolling or undulating relief resembles hummocky relief but has broader ridgetops and longer, more even side slopes.

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.*

Leaching. The removal of soluble materials from soils or other material by percolating water.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

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.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Permeability. The quality that enables the soil to transmit water or air. In this survey permeability applies to that part of the soil below the Ap or equivalent layer and above a depth of 60 inches, or to a lithic or paralithic contact at a shallower depth. The classes of permeability used in this survey are:

Inches per hour	*Class*	*Inches per hour*	*Class*
Less than 0.063	Very slow	2.00–6.30	Moderately rapid
0.063–0.20	Slow	6.30–20.00	Rapid
0.20–0.63	Moderately slow	More than 20.00	Very rapid
6.30–2.00	Moderate		

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 series, 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.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by 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	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a highly alkaline reaction; or contains harmful salts and exchangeable sodium and is strongly alkaline in reaction. The salts, exchangeable sodium, and alkaline reaction occur in the soil in such location that growth of most crop plants is less than normal.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

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.

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 layer, are similar in differentiating characteristics and in arrangement in the profile.

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.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Slope. The inclination of the land surface from the horizontal; percentage of slope is the vertical distance, divided by horizontal distance, times 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

Percent	*Class*
0–1	Nearly level
1–3	Very gently sloping or very gently undulating
3–7	Gently sloping or gently rolling
7–12	Moderately sloping or moderately rolling
12–17	Strongly sloping or rolling
17–31	Moderately steep or hilly to steep
More than 31	Very steep

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 principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Subsurface layer. The layer next to the surface layer; normally a part of the A horizon.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon; has no depth limit.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

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.

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 rock at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

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. In referring to a capability unit, a range site, or a windbreak suitability group, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, page 9.
Predicted yields, table 2, page 46.

Engineering uses of the soils, tables 5, 6, and 7, pages 60 through 73.

			Capability unit				Range site	Windbreak suitability group
			Dryland		Irrigated			
Map symbol	Mapping unit	Page	Symbol	Page	Symbol	Page	Name	Name
BdC	Burchard clay loam, 7 to 12 percent slopes	10	IIIe-1	40	IVe-1	40	Silty	Silty to Clayey
BdC2	Burchard clay loam, 7 to 12 percent slopes, eroded	11	IIIe-1	40	IVe-1	40	Silty	Silty to Clayey
BRD	Burchard-Steinauer clay loams, 12 to 17 percent slopes	11	IVe-11	44	-----	--	-----	Silty to Clayey
	Burchard soil	--	-----	--	-----	--	Silty	---------------
	Steinauer soil	--	-----	--	-----	--	Limy Upland	---------------
BRD2	Burchard-Steinauer clay loams, 12 to 17 percent slopes, eroded	11	IVe-11	44	-----	--	-----	Silty to Clayey
	Burchard soil	--	-----	--	-----	--	Silty	---------------
	Steinauer soil	--	-----	--	-----	--	Limy Upland	---------------
BT	Butler-Slickspots complex	12	IIIs-1	43	IIIs-1	43	-----	---------------
	Butler soils	--	-----	--	-----	--	Clayey	Silty to Clayey
	Slickspots soil	--	-----	--	-----	--	Saline Lowland	Moderately Saline-alkali
Bu	Butler silt loam	12	IIw-2	39	IIw-2	39	Clayey	Silty to Clayey
2Bu	Butler silt loam, terrace	12	IIw-2	39	IIw-2	39	Clayey	Silty to Clayey
By	Breaks-Alluvial land complex	9	VIe-9	46	-----	--	-----	Silty to Clayey
	Breaks	--	-----	--	-----	--	Silty	---------------
	Alluvial land	--	-----	--	-----	--	Silty Overflow	---------------
Ce	Crete silt loam, 0 to 1 percent slopes	13	IIs-2	39	IIs-2	39	Clayey	Silty to Clayey
CeA	Crete silt loam, 1 to 3 percent slopes	13	IIe-2	38	IIe-2	38	Clayey	Silty to Clayey
2CeA	Crete silt loam, terrace, 1 to 3 percent slopes	13	IIe-2	38	IIe-2	38	Clayey	Silty to Clayey
Fm	Fillmore silt loam	14	IIIw-2	43	IIs-21	43	Clayey Overflow	Moderately Wet
GeB2	Geary silty clay loam, 3 to 7 percent slopes, eroded	15	IIIe-11	42	IIIe-1	42	Silty	Silty to Clayey
GeC2	Geary silty clay loam, 7 to 12 percent slopes, eroded	16	IVe-1	43	IVe-12	43	Silty	Silty to Clayey
GeC3	Geary silty clay loam, 7 to 12 percent slopes, severely eroded	16	IVe-8	44	-----	--	Silty	Silty to Clayey
GeE3	Geary silty clay loam, 12 to 31 percent slopes, severely eroded	16	VIe-8	46	-----	--	Silty	Silty to Clayey
Ha	Hall silt loam, 0 to 1 percent slopes	17	I-1	38	I-1	38	Silty Lowland	Silty to Clayey
HaA	Hall silt loam, 1 to 3 percent slopes	17	IIe-1	38	IIe-1	38	Silty Lowland	Silty to Clayey
2Hb	Hobbs silt loam, occasionally flooded	21	IIw-3	39	IIw-3	39	Silty Overflow	Moderately Wet
Hb	Hobbs silt loam, 0 to 1 percent slopes	21	I-1	38	I-1	38	Silty Lowland	Silty to Clayey
HbA	Hobbs silt loam, 1 to 3 percent slopes	22	IIe-1	38	IIe-1	38	Silty Lowland	Silty to Clayey
HbB	Hobbs silt loam, 3 to 7 percent slopes	22	IIIe-11	42	IIIe-1	42	Silty Lowland	Silty to Clayey
Hc	Hobbs silty clay loam, 0 to 1 percent slopes	22	I-1	38	I-1	38	Silty Lowland	Silty to Clayey
Hd	Hord silt loam, 0 to 1 percent slopes	23	I-1	38	I-1	38	Silty Lowland	Silty to Clayey
HnA3	Hastings soils, 1 to 3 percent slopes, severely eroded	20	IIIe-8	41	IIe-11	41	Silty	Silty to Clayey
HSz	Hall-Slickspots complex, 1 to 3 percent slopes	17	IIIs-1	43	IIIs-1	43	-----	---------------
	Hall soil	--	-----	--	-----	--	Silty Lowland	Silty to Clayey
	Slickspots	--	-----	--	-----	--	Saline Lowland	Moderately Saline-alkali
Hs	Hastings silt loam, 0 to 1 percent slopes	18	I-1	38	I-1	38	Silty	Silty to Clayey
HsA	Hastings silt loam, 1 to 3 percent slopes	19	IIe-1	38	IIe-1	38	Silty	Silty to Clayey
HtA2	Hastings silty clay loam, 1 to 3 percent slopes, eroded	19	IIe-1	38	IIe-1	38	Silty	Silty to Clayey

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Page	Capability unit Irrigated Symbol	Page	Range site Name	Windbreak suitability group Name
HtB2	Hastings silty clay loam, 3 to 7 percent slopes, eroded---------	19	IIIe-11	42	IIIe-1	42	Silty	Silty to Clayey
2HtB2	Hastings silty clay loam, terrace, 3 to 7 percent slopes, eroded--	20	IIIe-11	42	IIIe-1	42	Silty	Silty to Clayey
HtB3	Hastings silty clay loam, 3 to 7 percent slopes, severely eroded-------------------------	19	IIIe-81	42	IIIe-11	42	Silty	Silty to Clayey
HtC2	Hastings silty clay loam, 7 to 12 percent slopes, eroded------	19	IVe-1	43	IVe-12	43	Silty	Silty to Clayey
HtC3	Hastings silty clay loam, 7 to 12 percent slopes, severely eroded------------------------	20	IVe-81	45	IVe-13	45	Silty	Silty to Clayey
HtD3	Hastings silty clay loam, 12 to 17 percent slopes, severely eroded------------------------	20	VIe-8	46	-----	--	Silty	Silty to Clayey
Lb	Lamo silty clay loam-------------	24	IIw-4	40	IIw-4	40	Subirrigated	Moderately Wet
LonC2	Longford silty clay loam, 5 to 12 percent slopes, eroded------	24	IVe-2	44	-----	--	Clayey	Silty to Clayey
M	Marsh---------------------------	24	VIIIw-1	47	-----	--	-----	Undesirable
MlD2	Meadin soils, 7 to 31 percent slopes, eroded-----------------	26	VIs-4	46	-----	--	Shallow to Gravel	Shallow
MrC2	Morrill clay loam, 7 to 12 percent slopes, eroded------------	26	IIIe-1	40	IVe-1	40	Silty	Silty to Clayey
PaB3	Pawnee soils, 3 to 7 percent slopes, severely eroded--------	28	IVe-4	44	-----	--	Dense Clay	Silty to Clayey
PaC3	Pawnee soils, 7 to 12 percent slopes, severely eroded--------	28	VIe-4	45	-----	--	Dense Clay	Silty to Clayey
PwB	Pawnee clay loam, 3 to 7 percent slopes-------------------------	27	IIIe-2	40	IIIe-2	40	Clayey	Silty to Clayey
PwB2	Pawnee clay loam, 3 to 7 percent slopes, eroded-----------------	27	IIIe-2	40	IIIe-2	40	Clayey	Silty to Clayey
PwD	Pawnee clay loam, 7 to 12 percent slopes--------------------	28	IVe-2	44	-----	--	Clayey	Silty to Clayey
PwD2	Pawnee clay loam, 7 to 12 percent slopes, eroded------------	28	IVe-2	44	-----	--	Clayey	Silty to Clayey
RB	Rough broken land, loess---------	28	VIIe-1	47	-----	--	Thin Loess	Undesirable
RBg	Rough broken land, till----------	29	VIIe-1	47	-----	--	Limy Upland	Undesirable
Sc	Scott silt loam------------------	30	IVw-2	45	IVw-2	45	-----	Undesirable
ShB2	Sharpsburg silty clay loam, 3 to 7 percent slopes, eroded-------	31	IIIe-11	42	IIIe-1	42	Silty	Silty to Clayey
ShB3	Sharpsburg silty clay loam, 3 to 7 percent slopes, severely eroded------------------------	31	IIIe-81	42	IIIe-11	42	Silty	Silty to Clayey
ShD2	Sharpsburg silty clay loam, 7 to 12 percent slopes, eroded------	31	IIIe-1	40	IVe-1	40	Silty	Silty to Clayey
ShD3	Sharpsburg silty clay loam, 7 to 12 percent slopes, severely eroded------------------------	31	IIIe-82	42	IVe-11	42	Silty	Silty to Clayey
ShE3	Sharpsburg silty clay loam, 12 to 17 percent slopes, severely eroded------------------------	32	IVe-8	44	-----	--	Silty	Silty to Clayey
SkC	Shelby clay loam, 7 to 12 percent slopes-------------------------	32	IIIe-1	40	IVe-1	40	Silty	Silty to Clayey
SkC2	Shelby clay loam, 5 to 12 percent slopes, eroded------------	33	IIIe-1	40	IVe-1	40	Silty	Silty to Clayey
StC2	Steinauer clay loam, 7 to 12 percent slopes, eroded---------	34	IVe-8	44	-----	--	Limy Upland	Silty to Clayey
StE	Steinauer clay loam, 12 to 31 percent slopes-----------------	34	VIe-9	46	-----	--	Limy Upland	Silty to Clayey
StE2	Steinauer clay loam, 12 to 31 percent slopes, eroded---------	34	VIe-8	46	-----	--	Limy Upland	Silty to Clayey
Sy	Silty alluvial land--------------	33	VIw-1	47	-----	--	Silty Overflow	Moderately Wet
Wt	Wymore silty clay loam, 0 to 1 percent slopes------------------	36	IIs-2	39	IIs-2	39	Clayey	Silty to Clayey
WtA	Wymore silty clay loam, 1 to 3 percent slopes------------------	36	IIe-2	38	IIe-2	38	Clayey	Silty to Clayey
WtB2	Wymore silty clay loam, 3 to 7 percent slopes, eroded---------	36	IIIe-2	40	IIIe-2	40	Clayey	Silty to Clayey
Wx	Wet alluvial land----------------	35	Vw-1	45	-----	--	Wet Land	Very Wet
WyC2	Wymore soils, 7 to 9 percent slopes, eroded-----------------	36	IVe-2	44	-----	--	Dense Clay	Silty to Clayey

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.