SOIL SURVEY OF

Polk County, Nebraska

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

Issued April 1974

Major fieldwork for this soil survey was done in the period 1961–65. 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 part of the technical assistance furnished to the Upper Big Blue and Central Platte 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 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 Polk 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 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 in the soil descriptions and in the descriptions of the range sites and windbreak groups.

Foresters and others can refer to the section "Management of the 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."

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.

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

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

Newcomers in Polk County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

Cover picture: **Nearly level to very gently sloping Hastings and Holder soils in the southern part of Polk County. (Photo courtesy of Richard Hufnagle.)**

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SOIL SURVEY OF POLK COUNTY, NEBRASKA

BY VERNON C. SEEVERS AND ROBERT S. POLLOCK, SOIL CONSERVATION SERVICE

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

POLK COUNTY is located in east-central Nebraska (fig. 1). The Platte River forms the northern boundary. The western boundary is 9 miles long, and the eastern boundary is 24 miles long.

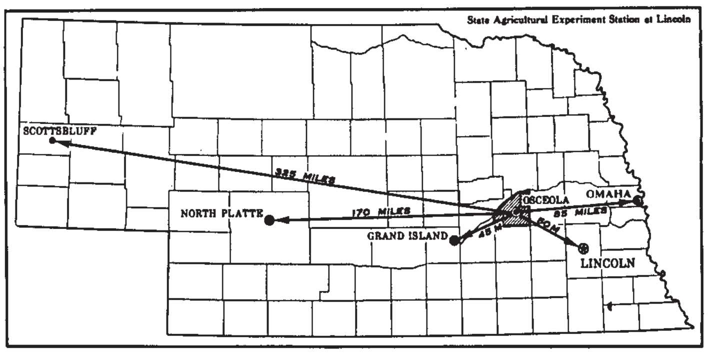

Figure 1.—Location of Polk County in Nebraska.

The total land area is 433 square miles, or 277,120 acres. Osceola is the county seat, and Stromsburg is the largest town. The largest enterprise in the county is farming, mainly general livestock and cash-grain farming. About four-fifths of the county is cropland, and much of it is irrigated. About one-fifth of the county has never been plowed and is still in native grass.

Deep-well irrigation has become an important part of Polk County farming since 1955. Corn and grain sorghum are the most important irrigated crops. The principal dryland crops are corn, grain, sorghum, wheat, and alfalfa. Livestock production in the county is mainly beef cattle and swine.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Polk 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, 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 a local survey (*8*).[1]

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 Fillmore, 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, Hastings silt loam, 0 to 1 percent slopes, is one of several phases within the Hastings 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. Only one such kind of mapping unit is shown on the soil map of Polk County, a soil complex.

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

[1] Italic numbers in parentheses refer to Literature Cited, p. 78.

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. Inavale-Platte 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. Silty alluvial land is a land type in Polk County.

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

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

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then 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 Polk 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 six soil associations in Polk County are described in the following pages. A given soil association in this county may be identified by a different name in a recently published soil survey of an adjacent county. Such differences in name result from changes in the concepts of soil classification that have occurred since publication.

1. Hastings association

Nearly level to moderately sloping, deep, silty soils on loess-mantled uplands

This soil association is part of a broad, upland loess plain. It is mostly nearly level to very gently sloping. The moderately sloping parts are along the few creeks and intermittent drainageways that dissect the association. Prairie Creek, Davis Creek, and the Big Blue River are the largest streams.

This soil association makes up about 32 percent of the county. It is about 85 percent Hastings soils. Less extensive soils make up the remaining 15 percent (fig. 2).

Hastings soils are on broad flats, in gently rolling areas, and along intermittent drainageways, creeks, and the Big Blue River. They formed in loess. They are deep and well drained. They have a surface layer of dark-gray silt loam and a subsoil of brown silty clay loam. The underlying material is light yellowish-brown silt loam.

Of minor extent in this association are the Fillmore, Hord, Hobbs, and Coly soils. Fillmore soils are in shallow upland depressions. Hobbs soils are on the bottoms of drainageways along intermittent streams. The steep Coly soils are along creeks and the Big Blue River. Hord soils are on stream terraces of the Big Blue River and some of the larger creeks.

Nearly all of this association is cultivated. Some of the steepest areas along creeks and intermittent drainageways are in native grass. Part of the association is under dryland management. Many areas are irrigated with water from deep wells. Corn, alfalfa, grain sorghum, and wheat are the principal crops.

The steeper soils are subject to water erosion, and much of the original surface layer has been removed in many cultivated areas. The annual precipitation limits crop production under dryland management. Maintaining fertility and managing water are concerns in irrigated areas.

Gravel roads are on nearly all section lines. Some hard-surfaced highways cross the association. Farm produce is marketed in Osceola, Stromsburg, Polk, and Shelby and at York in adjacent York County.

2. Holder association

Nearly level and very gently sloping, deep, silty soils on loess-mantled uplands

This association (see figure 2) is part of a broad, upland loess plain. It is mostly nearly level to very gently sloping. Steeper areas occur along the few intermittent drainageways that traverse the association.

This soil association makes up about 33 percent of the county. It is about 85 percent Holder soils. The remaining 15 percent is soils of minor extent.

Holder soils are deep and well drained. They formed in loess. They have a surface layer of dark grayish-brown silt loam and a subsoil of light brownish-gray, friable light silty clay loam. The underlying material is very pale brown silt loam.

Soils of minor extent in this association are the Fillmore, Butler, Hastings, and Hobbs soils. Fillmore soils are in shallow upland depressions. Butler soils are on flats and in very shallow depressions. Hastings soils are on some of the eroded sides of intermittent streams. Hobbs soils are in bottoms of drainageways.

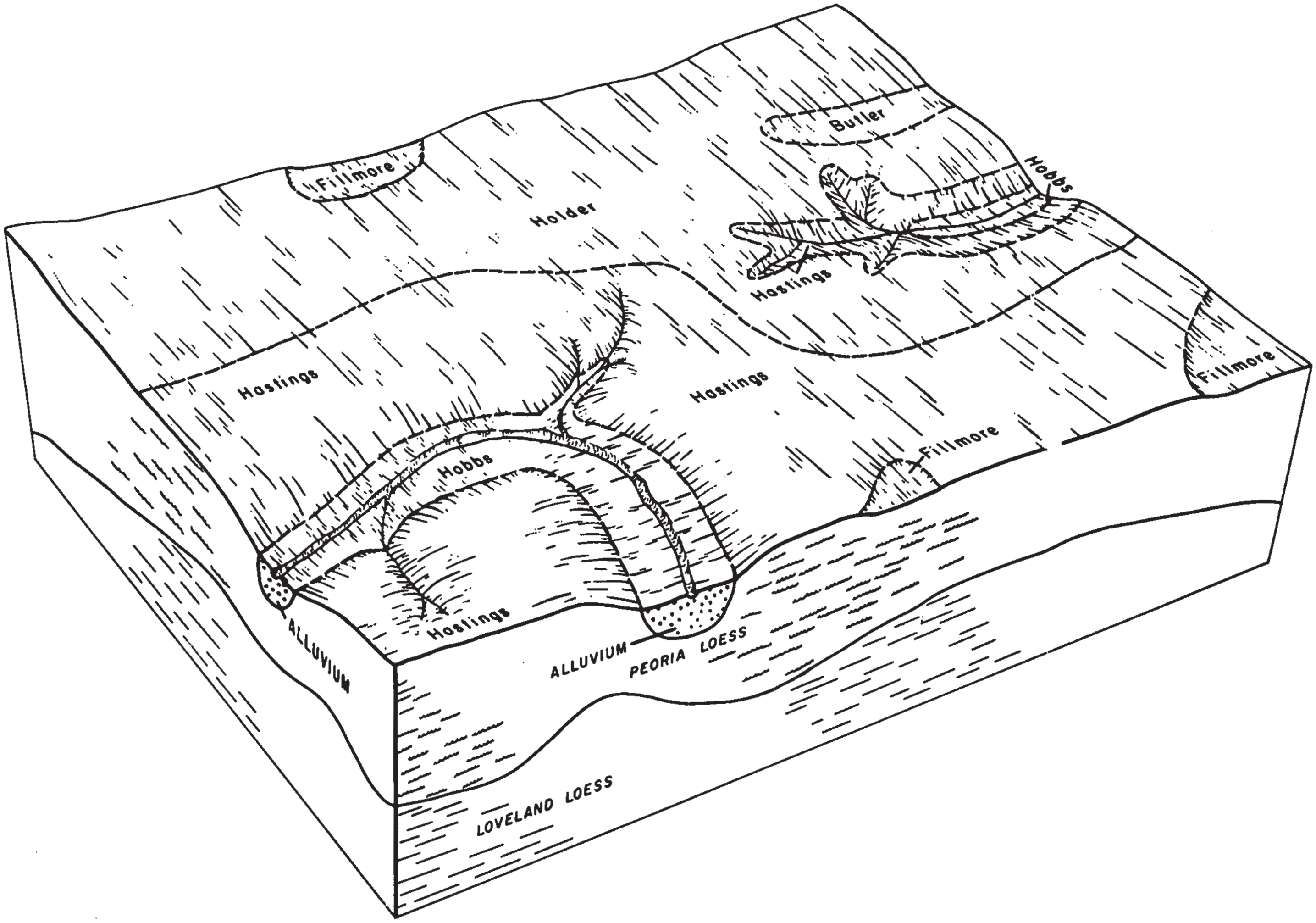

Figure 2.—**Typical pattern of soils and underlying material in associations 1 and 2.**

Nearly all of this association is cultivated. Many areas are irrigated from wells. Only a small acreage, mainly along streams, is still in native grass. Corn, grain sorghum, wheat, and alfalfa are the main cultivated crops. Farms are of the cash-grain or combination grain-livestock kind and range in size from 160 to 640 acres. Cattle and hogs are raised and fed for market.

Sparse precipitation is the main limiting factor in dry-farmed areas. Soil blowing is a hazard unless the surface is adequately protected. On the steeper soils, water erosion is a hazard. Maintaining fertility and managing water are the main concerns in irrigated areas.

Gravel roads are on nearly all section lines, and a few hard-surfaced roads cross the association. Farm produce is marketed in the nearby towns of Osceola, Stromsburg, Polk, and Shelby and at David City in Butler County.

3. Coly-Cozad association

Gently sloping to steep, deep, silty soils on upland breaks to the Platte River Valley

This association (fig. 3) is a long, narrow tract where the upland breaks to the Platte River Valley. It is mainly moderately sloping to steep. The steepest areas form short dendritic drainage patterns where geologic erosion is most active.

This association makes up about 8 percent of the county. It is about 55 percent Coly soils and 35 percent Cozad soils. The remaining 10 percent is soils of minor extent.

The moderately steep to steep Coly soils are along short, prominent, dendritic drainageways. They have a thin, grayish-brown silt loam surface layer and a light brownish-gray silt loam transitional layer. At a depth of 10 inches is light brownish-gray silt loam.

Cozad soils are on ridgetops and intervening areas between the steeper Coly soils. They are gently sloping to moderately sloping and have a dark-gray silt loam surface layer and a friable, grayish-brown silt loam subsoil. The underlying material is very pale brown silt loam.

Of minor extent in this association are the Ortello, Hobbs, and Holder soils and Rough broken land, loess. Ortello soils are at some of the lowest elevations and are commonly adjacent to the Platte River Valley. Rough broken land, loess, occurs where the landscape is steepest and where catsteps formed. Hobbs soils are in the widest bottoms of the drainageways. Holder soils are the least sloping and occupy the highest parts of the landscape.

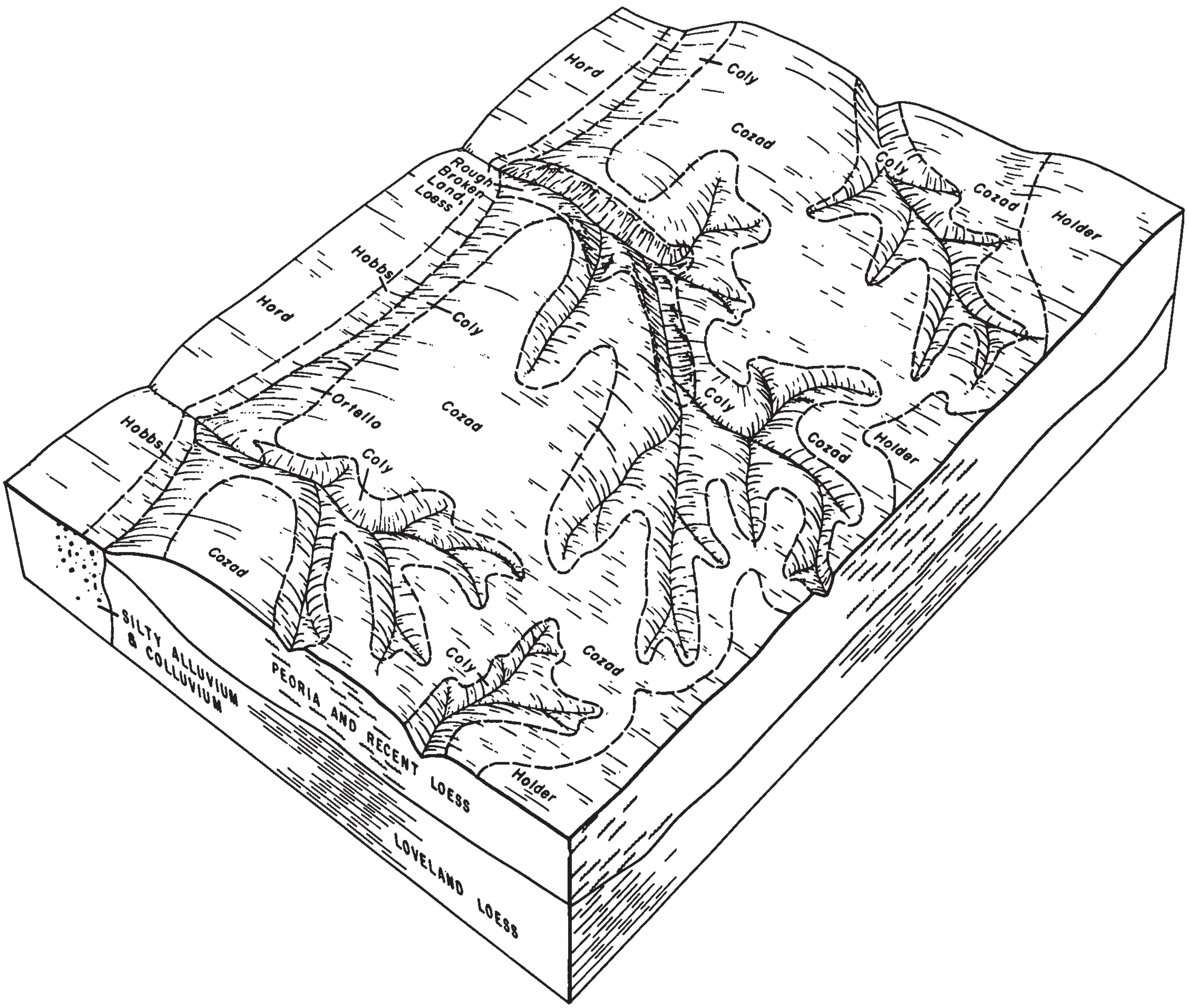

***Figure 3.*—Typical pattern of soils and underlying material in associations 3 and 4.**

Nearly all of this association is in native grass and is used for grazing. Only a few small areas are dryfarmed. Principal crops are wheat and grain sorghum. Land use is not intensive in this association.

Water erosion is a severe hazard in cultivated areas. Because the soils are steep, they are better suited to grass than to other uses. Good range management that keeps the grasses vigorous is essential.

Gravel roads are on most section lines. Improved dirt roads are on a few. On some section lines there are no roads and on others, only trails. Farmsteads are widely separated. The cattle raised are marketed at nearby sale pavilions or are trucked directly to large stock terminals.

4. Hord association

Nearly level, deep, silty soils on stream terraces

This association (see figure 3) is on stream terraces in the Platte River Valley and the Big Blue River Valley. It is nearly level. Some areas on the associated bottom lands, foot slopes, and terrace breaks are very gently sloping to gently sloping.

This association makes up 8 percent of the county. It is about 90 percent Hord soils. The remaining 10 percent is soils of minor extent.

Hord soils are deep, well drained, and nearly level. They have a dark grayish-brown silt loam surface layer and a friable, grayish-brown silt loam and loam subsoil. The underlying material is light brownish-gray very fine sandy loam.

The soils of minor extent are the Hall, Hobbs, and Cozad soils. Hall soils are in the Platte River Valley. They occupy slightly lower positions on the landscape than the Hord soils. Hobbs soils occupy the foot slopes and alluvial fans adjacent to the uplands. Cozad soils are on terraces at slightly higher elevations than the Hord soils.

Nearly all of this association is cultivated. Only a small acreage is in native grass. Much of the association is irrigated with water from wells. Corn, grain sorghum, and alfalfa are the main irrigated crops. Wheat and grain sorghum are the main dryland crops. The farms are of the cash-grain or general grain-livestock type.

If the soils are cultivated under a dryland system of management, inadequate precipitation is a limitation. Water erosion is not a major concern, but soil blowing can occur unless the soil is protected. Maintaining fertility and managing water are the principal concerns in irrigated areas.

Gravel roads are on nearly all section lines. Improved dirt roads are on a few. Adequate markets for farm produce are available in nearby towns of the county and in the adjacent Seward and Butler Counties.

5. Thurman-Meadin association

Nearly level to gently rolling, deep, sandy soils and shallow, sandy soils over mixed sand and gravel on stream terraces

This soil association is on stream terraces of the Platte River Valley. These soils are nearly level to gently rolling and sandy (fig. 4).

This association makes up about 4 percent of Polk County. It is about 53 percent Thurman soils, 30 percent Meadin soils, and 17 percent soils of minor extent.

Thurman soils are at the highest elevations. They are deep, somewhat excessively drained, and range from nearly level to gently rolling. The surface layer is grayish-brown loamy fine sand in the upper part and dark grayish-brown loamy sand in the lower part. The underlying material is very pale brown loamy sand.

Meadin soils are at the lower elevations. They are excessively drained, range from nearly level to gently sloping, and are shallow over sand and gravel. They have a surface layer of dark grayish-brown loamy sand and a transitional layer of grayish-brown loamy sand. At a depth of 17 inches is a mixture of light-gray sand and gravel.

Of minor extent in this association are the O'Neill and Blendon soils. The moderately deep O'Neill soils occupy slightly higher positions on the landscape than the shal-

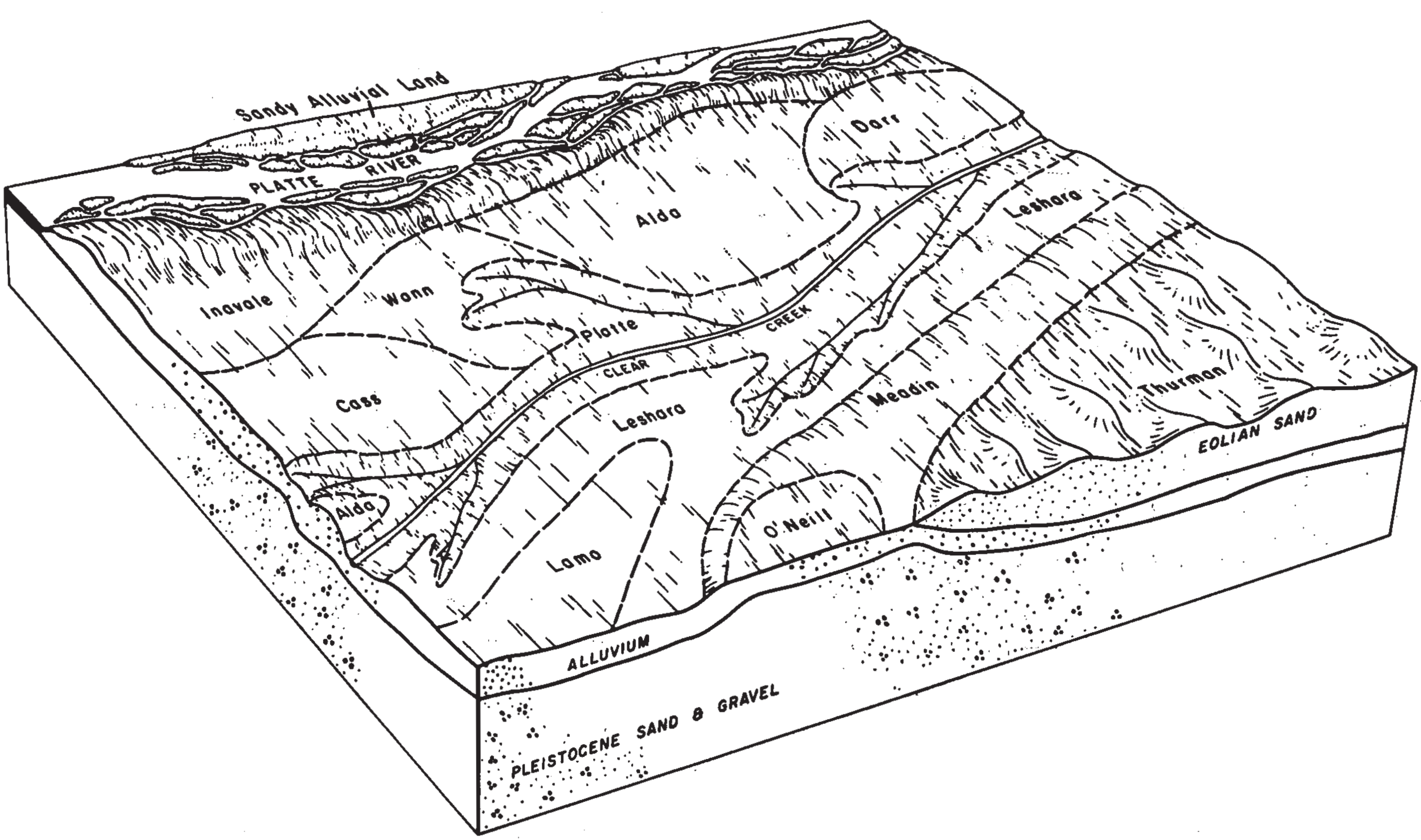

Figure 4.—**Typical pattern of soils and underlying material in associations 5 and 6.**

low Meadin soils. Blendon soils are at lower elevations than the Thurman soils, and they occupy the more concave areas of the landscape.

Most of this association is in native grass and is used for grazing. Some areas are cultivated. A few are irrigated. Wheat, alfalfa, corn, and grain sorghum are the main crops. Farms range from 320 to 640 acres in size, and most of them are of the grain-livestock type. Some grain is marketed for cash.

Inadequate moisture is the main limiting factor to the use of these soils for grassland or for dryland farming. The soils have very low to low available water capacity; thus, they are droughty. Unless protected by a grass cover or a growing crop, they are subject to blowing. Maintaining fertility and managing water are the principal concerns in irrigated areas.

Good gravel roads are on some section lines, but only dirt roads or trails are on others. Markets are readily available in the nearby towns of Shelby and Osceola and at David City in Butler County.

6. Platte-Leshara-Alda association

Nearly level and very gently sloping, shallow to deep, loamy soils over mixed sand and gravel on bottom lands of the Platte River Valley

This soil association (see figure 4) is on bottom land of the Platte River Valley. The soils are nearly level to very gently sloping. They are somewhat poorly drained because the water table fluctuates between depths of 2 and 6 feet.

This association makes up about 15 percent of the county. It is about 21 percent Platte soils, 18 percent Leshara soils, and 16 percent Alda soils. Less extensive soils make up the remaining 45 percent.

Platte soils are at the lowest elevations. They are shallow over mixed sand and gravel, somewhat poorly drained, and nearly level. Their surface layer is gray fine sandy loam. The underlying material is light brownish-gray very fine sandy loam in the upper part, light-gray loamy sand in the middle part, and mixed sand and gravel in the lower part.

Leshara soils are at the highest elevations. They are deep, somewhat poorly drained, and nearly level. Their surface layer is dark-gray silt loam. The underlying material is friable, light brownish-gray silt loam in the upper part and gray sandy loam in the lower part.

Alda soils are at intermediate elevations between Platte and Leshara soils. They are moderately deep over sand, somewhat poorly drained, and nearly level to very gently sloping. Their surface layer is dark-gray fine sandy loam. Below this is a transitional layer of grayish-brown fine sandy loam. The underlying material is light brownish-gray fine sandy loam in the upper part, light-gray coarse sand in the middle part, and coarse sand and gravel below a depth of 34 inches.

Of minor extent in this association are Wet alluvial land, Sandy alluvial land, and the Cass, Lamo, Wann, Darr, and Inavale soils. The well-drained Cass soils occupy higher positions on the landscape than the major soils. Lamo and Wann soils are at about the same elevation as Leshara soils. Inavale soils are on high ridges. Wet alluvial land occupies old abandoned channels of the Platte River. Sandy alluvial land is an area of stabilized riverwash adjacent to channels of the Platte River.

Most of this association is cultivated, and many of the cultivated areas are irrigated. Corn, grain sorghum, wheat, and alfalfa are the principal crops. Many areas are still in native grass and are used for grazing cattle and other livestock. Farms range from 160 to 640 acres in size, and most of them are of the grain-livestock type. Some grain is marketed for cash. Some garden crops are grown commercially.

Wetness, particularly in spring, is the main hazard. It commonly delays cultivation and planting. Soil blowing is a hazard unless the surface is protected. The soils are nearly level and very gently sloping and are not susceptible to serious water erosion.

This association has a network of gravel roads. On some section lines, they are only dirt roads, and on other lines there are no roads. Farmsteads are numerous. Farm products are marketed in nearby towns of Polk County and in towns of adjacent counties.

Descriptions of the Soils

This section describes the soil series and mapping units in Polk County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to the underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless it is otherwise stated, the colors given in the descriptions are those of a dry soil.

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

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

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*8*).

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

Soils	Area	Extent
	Acres	*Percent*
Alda fine sandy loam	3, 379	1. 2
Alda loam	1, 684	. 6
Blendon fine sandy loam, 0 to 1 percent slopes	526	. 2
Blendon fine sandy loam, 1 to 3 percent slopes	1, 862	. 7
Butler silt loam	1, 230	. 5
Cass fine sandy loam	5, 333	2. 0
Coly silt loam, 11 to 31 percent slopes	10, 032	3. 7
Cozad silt loam, 3 to 7 percent slopes	5, 306	1. 9
Cozad silt loam, 7 to 11 percent slopes	1, 460	. 5
Cozad silt loam, terrace, 0 to 1 percent slopes	1, 909	. 7
Cozad silt loam, terrace, 1 to 3 percent slopes	719	. 3
Cozad silt loam, terrace, 3 to 7 percent slopes	748	. 3
Cozad soils, 3 to 7 percent slopes, severely eroded	1, 896	. 8
Cozad soils, 7 to 11 percent slopes, severely eroded	8, 655	3. 2
Cozad-Slickspots complex, terrace	788	. 3
Darr fine sandy loam	3, 015	1. 1
Fillmore silt loam	9, 524	3. 4
Gravel pits	273	. 1
Hall silt loam, 0 to 1 percent slopes	1, 695	. 6
Hastings silt loam, 0 to 1 percent slopes	53, 865	19. 6
Hastings silt loam, 1 to 3 percent slopes	5, 453	2. 0
Hastings silt loam, 3 to 7 percent slopes	2, 583	. 9
Hastings soils, 3 to 7 percent slopes, severely eroded	772	. 2
Hastings soils, 7 to 11 percent slopes, severely eroded	7, 008	2. 5
Hobbs silt loam, 0 to 3 percent slopes	5, 100	1. 8
Hobbs silt loam, 3 to 7 percent slopes	862	. 3
Hobbs silt loam, occasionally flooded	3, 438	1. 2
Holder silt loam, 0 to 1 percent slopes	60, 918	21. 5
Holder silt loam, 1 to 3 percent slopes	19, 665	7. 1
Hord silt loam, 0 to 1 percent slopes	13, 324	4. 8
Inavale loamy fine sand, 0 to 3 percent slopes	1, 279	. 5
Inavale loamy sand, 3 to 7 percent slopes	1, 789	. 6
Inavale-Platte complex	748	. 3
Lamo silty clay loam, sandy substratum	4, 541	1. 6
Leshara silt loam	3, 103	1. 1
Leshara silt loam, drained	4, 201	1. 6
Meadin loamy sand, 0 to 5 percent slopes	3, 291	1. 2
O'Neill fine sandy loam, 0 to 1 percent slopes	309	. 1
Ortello complex, 7 to 11 percent slopes	390	. 1
Ortello complex, 7 to 11 percent slopes, eroded	365	. 1
Ortello-Coly complex, 11 to 31 percent slopes	601	. 2
Platte fine sandy loam	5, 474	2. 0
Platte-Alda complex	3, 976	1. 4
Rough broken land, loess	591	. 2
Sandy alluvial land	2, 376	. 9
Silty alluvial land	1, 894	. 7
Thurman loamy sand, 0 to 5 percent slopes	4, 625	1. 7
Thurman loamy sand, 5 to 11 percent slopes	1, 150	. 4
Wann fine sandy loam	1, 321	. 5
Wet alluvial land-Alda complex	2, 074	. 8
Total	277, 120	100. 0

A given soil in this county may be identified by a different name in a recently published soil survey of an adjacent county. Such differences in name result from changes in the concepts of soil classification that have occurred since publication. The characteristics of the soils described in this county are considered to be within the range defined for that series. In those instances where a soil has one or more features outside the defined range, the differences are explained.

Alda Series

The Alda series consists of nearly level to very gently sloping, somewhat poorly drained soils on the Platte River bottom land. These soils are moderately deep over sand and gravel. A water table fluctuates between depths of 2 and 6 feet. At a depth of 20 to 40 inches is mixed sand and gravel.

In a representative profile, the surface layer is dark-gray fine sandy loam about 11 inches thick. Beneath this is a transitional layer of grayish-brown, calcareous fine sandy loam about 6 inches thick. The upper part of the underlying material is light brownish-gray, soft, calcareous fine sandy loam. At a depth of 29 inches is light-gray coarse sand, and at a depth of 34 inches is mixed coarse sand and gravel.

Alda soils have moderately rapid permeability and low available water capacity. The organic-matter content is moderate, and natural fertility is medium.

Most of the acreage is cultivated, and much of this is irrigated. The rest is in native grass and is used as rangeland or mowed for hay. These soils are suitable for windbreak plantings and for use by wildlife.

Representative profile of Alda fine sandy loam in a cultivated field 0.3 mile north and 50 feet east of the southwest corner of sec. 12, T. 16 N., R. 1 W.:

Ap—0 to 8 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak, fine, granular structure; soft, very friable; neutral; abrupt; smooth boundary.

A12—8 to 11 inches, dark-gray (10 YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak, medium, subangular blocky structure parting to weak, fine, graular; soft, very friable; neutral; clear, wavy boundary.

AC—11 to 17 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to fine granular; soft, very friable; moderately alkaline; calcareous; clear, wavy boundary.

C1—17 to 29 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, subangular blocky structure parting to weak, fine to very fine, granular; soft, very friable; mildly alkaline; calcareous; clear, wavy boundary.

IIC2—29 to 34 inches, light-gray (10YR 7/2) coarse sand, light brownish gray (10YR 6/2) moist; single grain; loose; mildly alkaline; gradual, wavy boundary.

IIC3—34 to 60 inches, light brownish-gray (10YR 6/2) mixed coarse sand and gravel, grayish brown (10YR 5/2) moist; common, medium, distinct, black (10YR 2/1) mottles; single grain; loose; neutral; water table at a depth of 60 inches.

The A horizon ranges from 10 to 18 inches in thickness. It is silt loam or fine sandy loam. In places the C horizon is stratified with soil material that ranges from medium textured to coarse textured. Depth to mixed sand and gravel ranges from 20 to 40 inches. Depth to lime ranges from 0 to 12 inches.

Alda soils are near Platte, Wann, Leshara, Darr, and Inavale soils. They are deeper over sand and gravel than the shallow Platte soils. They are not so deep as the deep Wann soils. They are deeper than Leshara soils and have a coarser textured C horizon. They have a higher water table than Darr and Inavale soils. They are finer textured in the C horizon than Inavale soils.

Alda fine sandy loam (0 to 1 percent slopes) (Ax).—This moderately deep soil is nearly level and very friable.

It formed in loamy alluvium on bottom land. Areas are irregular in shape and range from 10 to 40 acres in size.

This soil has the profile described as representative for the Alda series. Included in mapping were small areas of Wann fine sandy loam, Platte fine sandy loam, and Alda loam; some areas that have a buried soil in the underlying material; and many areas where lime is at the surface.

Wetness is a limitation in spring and commonly delays planting and cultivation. In fall, however, when the water table is lowest, crops are damaged by lack of moisture. Soil blowing is a hazard unless the surface is protected. Runoff is slow.

Nearly all areas are cultivated. Corn, grain sorghum, wheat, and alfalfa are the crops commonly grown. Some areas are irrigated. This soil is suitable for windbreak plantings and for use by wildlife. Capability units IIw-6 dryland and IIw-6 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Alda loam (0 to 1 percent slopes) (Ay).—This is a nearly level, moderately deep soil. It formed in alluvium on bottom land of the Platte River Valley. Areas are irregular in shape and range from about 10 to 40 acres in size.

This soil has a profile similar to the one described as representative for the Alda series, but it has a loam surface layer. Included with this soil in mapping were small areas of Alda fine sandy loam, Wann fine sandy loam, Leshara silt loam, and Platte fine sandy loam, and a few small areas where the soils are moderately affected by soluble salts and alkali.

Wetness is a limitation, particularly in spring when rains are heaviest and the water table is highest. It commonly delays planting. Surface runoff is slow.

Nearly all areas are cultivated. Corn, grain sorghum, wheat, and alfalfa are the commonly grown crops. Some areas are irrigated. This soil is suitable for growing trees and for use by wildlife. Capability units IIw-4 dryland and IIw-4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Blendon Series

The Blendon series consists of deep, very friable soils. These soils are nearly level to very gently sloping and are well drained. They formed in alluvium on stream terraces in the Platte River Valley.

In a representative profile, the surface layer is fine sandy loam about 20 inches thick. It is dark grayish brown in the upper part and dark gray in the lower part. The subsoil is very friable, grayish-brown fine sandy loam about 10 inches thick. The underlying material is brown fine sandy loam to a depth of about 56 inches and below this, pale-brown silt loam.

Blendon soils have moderately rapid permeability and high available water capacity. The organic-matter content is low, and natural fertility is medium.

Most of the acreage is cultivated. These soils are well suited to irrigation. Areas still in native grass are used as rangeland or are mowed for hay.

Representative profile of Blendon fine sandy loam, 1 to 3 percent slopes, in a hay meadow 0.5 mile south and 50 feet west of the northeast corner of sec. 1, T. 15 N., R. 2 W.:

A11—0 to 14 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

A12—14 to 20 inches, dark-gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak, fine and medium, subangular blocky structure; soft, very friable; neutral; clear, smooth boundary.

B—20 to 30 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure parting to weak, fine, subangular blocky; soft, very friable; neutral; clear, wavy boundary.

C1—30 to 56 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, coarse, subangular blocky structure; soft, very friable; neutral; abrupt, smooth boundary.

IIC2—56 to 60 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; slightly hard, friable; mildly alkaline.

The A horizon ranges from 9 to 20 inches in thickness and from dark gray to grayish brown in color. The B horizon ranges from 8 to 20 inches in thickness and from grayish brown to dark grayish brown in color. The lower part of the C horizon ranges from silt loam to a mixture of sand and gravel.

Blendon soils are near Hord, Hall, Thurman, and Meadin soils. They are coarser textured than Hord or Hall soils, but not so coarse textured as Thurman and Meadin soils. They are deeper than the shallow Meadin soils.

Blendon fine sandy loam, 0 to 1 percent slopes (Bdn).—This deep, moderately coarse soil is on stream terraces.

This soil has a profile similar to the one described as representative for the series but in some areas, the combined surface layer and subsoil are only 10 to 20 inches thick, and in other areas there are buried, dark-colored layers in the underlying material. Included with this soil in mapping were small areas of Hord silt loam.

Soil blowing is a hazard unless the soil is adequately protected. Runoff is slow. Water erosion is no particular hazard. The soil is easy to work. Maintaining fertility and managing water are concerns in irrigated areas.

Most of the acreage is cultivated. Corn, wheat, grain sorghum, and alfalfa are the principal crops. A few areas are in native grass and are used for range or hay. This soil is suited to windbreak plantings. The areas are used by wildlife as a source of food. Capability units IIe-3 dryland and IIe-3 irrigated; Sandy range site; Sandy windbreak group.

Blendon fine sandy loam, 1 to 3 percent slopes (BdnA).—This very friable soil is on stream terraces in the Platte River Valley.

This soil has the profile described as representative for the series. Included in mapping were small areas where the slope is 3 to 5 percent, areas where the surface layer and subsoil combined are less than 20 inches thick, and other areas where the plow layer is loamy fine sand.

Soil blowing is the principal hazard in cultivated areas. Surface runoff is slow. Water erosion is not a severe hazard, but in some of the more sloping areas the soil is erodible. This soil is easy to work. Under dryland management it is droughty in years of subnormal rainfall. Maintaining fertility and managing water are the principal concerns in irrigated areas.

Nearly all areas are cultivated, and many are irrigated. The soil is well suited to trees. Areas are used by wildlife for food and cover. A few areas are still in native grass. Capability units IIIe-3 dryland and IIIe-3 irrigated; Sandy range site; Sandy windbreak group.

Butler Series

The Butler series consists of deep, nearly level, somewhat poorly drained soils. These soils formed in level areas and in slight swales and shallow depressions in the loess uplands.

In a representative profile, the surface layer is dark-gray silt loam 9 inches thick. Beneath this is a layer of gray silt loam 3 inches thick. The upper 20 inches of the subsoil, a claypan, is very firm, dark-gray silty clay, and the lower 9 inches is firm, grayish-brown silty clay loam. The material at a depth of 41 inches is calcareous silt loam. It is grayish brown in the upper part and light gray in the lower part.

Butler soils have a high available water capacity, but are droughty if dryfarmed. The subsoil is slowly permeable. The organic-matter content is moderate, and natural fertility is high.

Most of the acreage is cultivated, and much of this is irrigated. A few areas are in native grass.

Representative profile of Butler silt loam in a cultivated field 150 feet west and 50 feet south of the northeast corner of sec. 34, T. 14 N., R. 4 W.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; slightly hard, friable; medium acid; abrupt, smooth boundary.

A12—6 to 9 inches, dark-gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; moderate, medium, blocky structure; slightly hard, friable; slightly acid; clear, smooth boundary.

A2—9 to 12 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, fine, granular structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

B2t—12 to 32 inches, dark-gray (10YR 4/1) silty clay, very dark grayish brown (10YR 3/2) moist; strong, medium, prismatic structure parting to strong, medium, subangular blocky; very hard, very firm; clay coatings on ped faces; neutral; gradual, smooth boundary.

B3—32 to 41 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, subangular blocky structure; hard, firm; mildly alkaline; clear, smooth boundary.

C1—41 to 50 inches, grayish-brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky; slightly hard, friable; calcareous; moderately alkaline; clear, smooth boundary.

C2—50 to 60 inches, light-gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; few, fine, faint, reddish and grayish mottles; weak, coarse, prismatic structure; slightly hard, friable; calcareous; moderately alkaline.

The A horizon ranges from 8 to 17 inches in thickness. It is medium acid or slightly acid. The A2 horizon ranges from 1 to 3 inches in thickness. The B horizon ranges from 18 to 30 inches in thickness and from silty clay to clay in texture. The depth to lime ranges from 32 to 54 inches.

Butler soils are near Fillmore, Hastings, and Holder soils. They are better drained than Fillmore soils and have a less prominent A2 horizon. They are more poorly drained than Hastings and Holder soils and have a darker, finer textured B horizon.

Butler silt loam (0 to 1 percent slopes) (Bu).—This nearly level claypan soil generally occurs as oval-shaped areas that range from 5 to 30 acres in size.

Included with this soil in mapping were small areas of Fillmore silt loam.

This soil is difficult to work when wet. Wetness, the main hazard in spring, commonly delays planting and cultivation. Little moisture penetrates the claypan subsoil. Late in summer this soil is droughty even though it has high available water capacity. Droughtiness occurs partly because rainfall is inadequate, but chiefly because little moisture has moved through the claypan. Thus, an inadequate amount has been stored in the lower part of the soil for use during dry periods. It is difficult for plant roots to pentrate the claypan, particularly after most of the moisture has been removed. The pan has a high shrink-swell potential.

Wheat and grain sorghum are the crops most commonly grown under dryland management. Corn is the crop most commonly grown under irrigation. This soil is suitable for windbreak plantings. Areas are used by wildlife for food and shelter. Capability units IIw-2 dryland and IIs-2 irrigated; Clayey range site; Silty to Clayey windbreak group.

Cass Series

The Cass series consists of deep, well-drained, moderately coarse textured soils. These soils are nearly level to very gently sloping. They formed in alluvium on bottom lands in the Platte River Valley.

In a representative profile, the surface layer is gray fine sandy loam about 19 inches thick. Beneath this is a transitional layer of grayish-brown, very friable fine sandy loam about 14 inches thick. The underlying material is light brownish-gray, very friable loamy sand in the upper part and brown sandy loam in the lower part.

Cass soils have moderately rapid permeability and moderate available water capacity. The organic-matter content is moderately low, and natural fertility is medium.

Most of the acreage is cultivated, and much of this is irrigated from wells. These soils are suited to all the crops commonly grown in the county. A few areas are in native grass and are used for grazing.

Representative profile of Cass fine sandy loam (0 to 3 percent slopes) in a cultivated field 0.25 mile east and 125 feet south of the northwest corner of sec. 11, T. 16 N., R. 1 W.:

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

A12—8 to 19 inches, gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak, medium to fine, granular structure; soft, very friable; slightly acid; clear, wavy boundary.

AC—19 to 33 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure; soft, very friable; neutral; clear, wavy boundary.

C1—33 to 50 inches, light brownish-gray (2.5Y 6/2) loamy sand, grayish brown (10YR 5/2) moist; single grain; soft, very friable; neutral; abrupt, smooth boundary.

IIAb—50 to 55 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; slightly hard, friable; neutral; abrupt, smooth boundary.

IIICb—55 to 60 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak, coarse, subangular blocky structure; soft, very friable; neutral.

The A horizon ranges from 9 to 20 inches in thickness. In many profiles the C horizon is stratified with material that ranges from medium textured to coarse textured. In some areas the lower part of the C horizon has few to many mottles.

Cass soils are near Wann, Leshara, and Inavale soils. They have a lower water table than Wann and Leshara soils. They are coarser textured than Leshara soils. They are not so coarse textured as Inavale soils.

Cass fine sandy loam (0 to 3 percent slopes) (Ca).—This level to very gently sloping soil is on bottom land. Most areas are irregular in shape and range from 10 to 60 acres in size.

Included in mapping were a few small areas of Inavale soils, small areas of soils underlain by a medium-textured material, and some areas where coarse sand and gravel are below a depth of 40 inches.

Soil blowing is a hazard unless the soil is adequately protected. Runoff is slow. Under dryland management this soil can be droughty. It responds well to fertilization and is easy to work. Maintaining fertility and managing water are concerns, particularly in irrigated areas.

Most of the acreage is cultivated. Corn, grain sorghum, wheat, and alfalfa are the crops commonly grown. Only a few areas are in native grass and these are used for grazing or mowed for hay. This soil is suitable for windbreak plantings. Areas are used by wildlife as shelter and a source of food. Capability units IIe–3 dryland and IIe–3 irrigated; Sandy Lowland range site; Sandy windbreak group.

Coly Series

The Coly series consists of medium-textured, well-drained soils. These are moderately steep to steep soils that formed in thick deposits of loess on uplands.

In a representative profile, the surface layer is grayish-brown silt loam about 6 inches thick. Beneath this is a 4-inch transitional layer (fig. 5) of very friable, light brownish-gray silt loam. It is underlain by friable, light-gray silt loam that is calcareous and mottled in the lower part.

Coly soils have moderate permeability and high available water capacity. The organic-matter content and natural fertility are low. Reaction is moderately alkaline throughout the profile.

Most areas are in native grasses. Some formerly cultivated areas have been reseeded to native grasses. A few are cultivated, but the soils are better suited to less intensive uses.

Representative profile of Coly silt loam, 11 to 31 percent slopes, in native rangeland 0.2 mile south and 600 feet west of the northeast corner of sec. 29, T. 15 N., R. 2 W.:

A—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable; calcareous; moderately alkaline; clear, smooth boundary.

AC—6 to 10 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, fine,

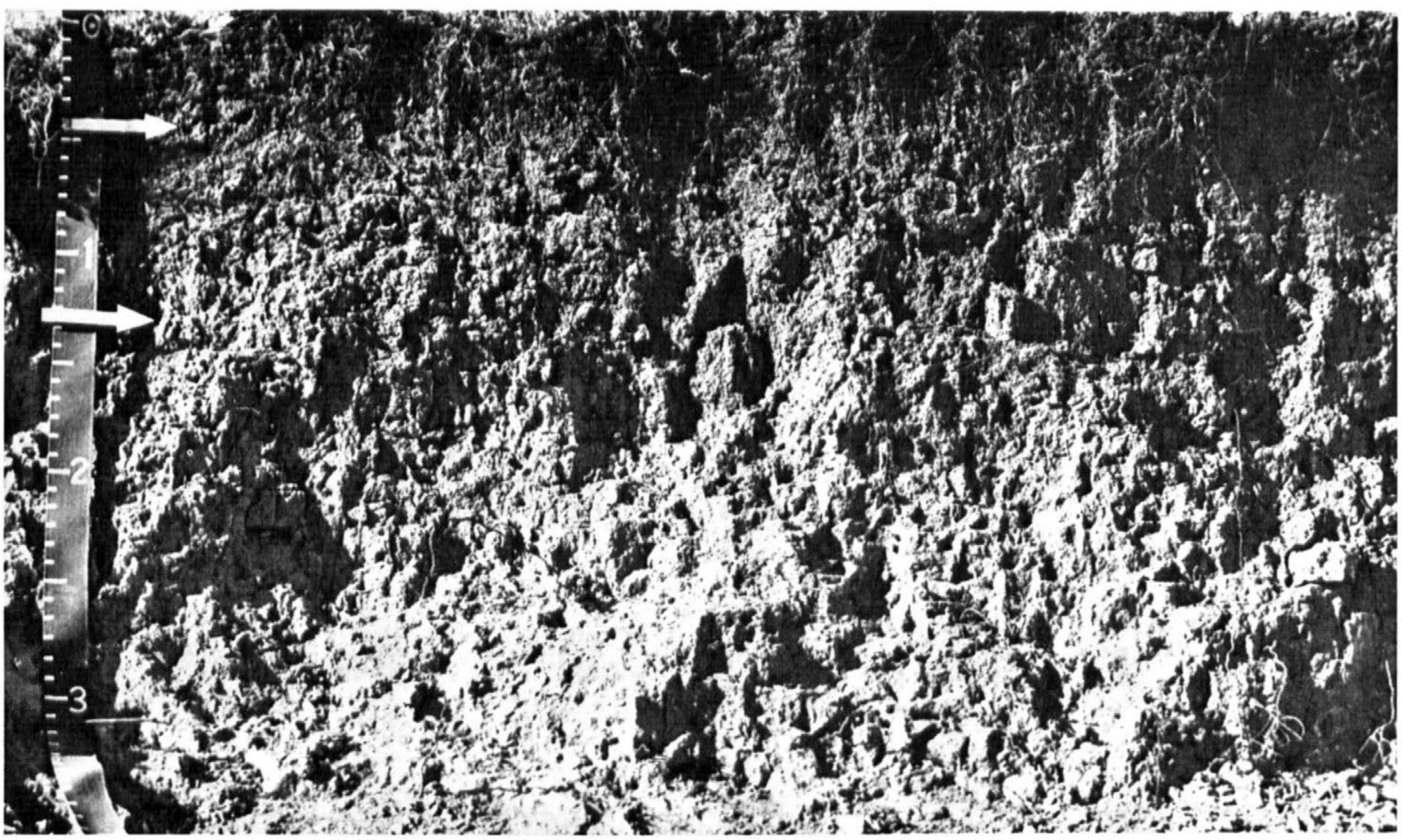

Figure 5.—Profile of Coly silt loam, a deep, immature, very friable soil. Arrow indicates boundary between surface layer and transitional layer.

granular structure; soft, very friable; calcareous; moderately alkaline; clear, smooth boundary.

C—10 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; few, fine, faint, relict, yellowish mottles in the lower part; massive; soft, very friable; calcareous; moderately alkaline.

The A horizon ranges from 3 to 6 inches in thickness and from grayish brown to light gray to very pale brown in color. Lime is within a depth of 10 inches.

Coly soils are near Holder, Hastings, Cozad, and Ortello soils. In contrast with Holder and Hastings soils, they have a thinner solum and less distinct horizons and are not so fine textured. They have a thinner solum than Cozad soils, and lime is higher in the profile. In contrast with Ortello soils, they are not so coarse textured and have a thinner A horizon.

Coly silt loam, 11 to 31 percent slopes (CbD).—This silty soil is along breaks to the Platte River Valley and along the sides of intermittent drainageways, creeks, and the Big Blue River. Areas are generally long and narrow and range from 5 to 80 acres in size.

This soil has the profile described as representative for the series. Included in mapping were small areas of Hobbs soils on the bottoms and lower slopes of drainageways; small areas of Cozad and Ortello soils and Rough broken land, loess; and a few small areas of a reddish-brown soil.

Because runoff is rapid, water erosion is a severe hazard. Much of the rainfall is lost as runoff from this moderately steep to steep soil.

This soil is not suited to cultivated crops, but it is well suited to pasture. Nearly all areas are in native grass and are used for grazing. The soil is also suited to trees. Areas are used by wildlife for shelter and nesting and as a source of food. Capability unit VIe–9 dryland; Limy Upland range site; Silty to Clayey windbreak group.

Cozad Series

The Cozad series consists of deep, well-drained, medium-textured soils. These soils are nearly level to moderately sloping and are on stream terraces, on upland breaks to the Platte River Valley, and along intermittent drainageways.

In a representative profile, the surface layer is dark-gray silt loam 10 inches thick. The subsoil is very friable, grayish-brown silt loam about 7 inches thick. The underlying material is calcareous silt loam. It is light brownish gray in the upper part and very pale brown in the lower part.

Cozad soils have moderate permeability and high available water capacity. Natural fertility is medium. The organic-matter content ranges from low to moderately low. The surface layer is slightly acid, and the subsoil is neutral.

Most of the acreage is cultivated, and much of this is irrigated. Many areas are still in native grass and are used for grazing.

Representative profile of Cozad silt loam, terrace, 0 to 1 percent slopes, in a cultivated field 1,000 feet north and 200 feet west of the southeast corner of sec. 16, T. 15 N., R. 2 W.:

Ap—0 to 6 inches, dark-gray (10YR 4/2) silt loam, very dark gray (10YR 3/1) moist; weak, medium, granular structure; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

A12—6 to 10 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, medium, blocky structure; slightly hard, very friable; clear, wavy boundary.

B—10 to 17 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; slightly hard, friable; neutral; clear, wavy boundary.

C1—17 to 24 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure; slightly hard, friable; calcareous; neutral; gradual, wavy boundary.

C2—24 to 60 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; calcareous; mildly alkaline.

The A horizon ranges from 6 to 12 inches in thickness. It is mainly dark gray or grayish brown, but it ranges to very pale brown in severely eroded areas. The B horizon ranges from 6 to 20 inches in thickness and from pale brown to grayish brown in color. It ranges from silt loam on stream terraces to light silty clay loam on the loess uplands. The depth to lime ranges from 15 to 60 inches. In mapping units CosB3 and CosC3, the surface layer is lighter colored than is defined in the range for the series, but this does not affect use or management.

Cozad soils are near Hastings, Holder, Hord, and Coly soils. Their B horizon is not so fine textured as that of Hastings and Holder soils. They have a thinner A horizon than Hord soils. In contrast with Coly soils, they have a thicker solum and are not so steep.

Cozad silt loam, 3 to 7 percent slopes (CozB).—This soil is along intermittent streams and on low ridges in the loess uplands. The higher slopes are convex, and the lower slopes are concave. Areas of this soil are irregular in shape and range from 10 to 100 acres in size.

This soil has a profile similar to the one described as representative for the series, but lime is at a greater depth. Included in mapping were small areas of Holder and Hobbs soils and small areas where erosion has removed nearly all of the original, dark-colored surface layer.

Water erosion is the most severe hazard. Runoff is rapid. Soil blowing occurs in areas where the surface layer is not adequately protected. Maintaining a high level of fertility is essential.

Nearly all areas are cultivated. Corn, grain sorghum, wheat, and alfalfa are the main crops. Only a few areas are irrigated. Some areas are still in native grass. The soil is suitable for trees and for use by wildlife. Capability units IIIe–1 dryland and IIIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Cozad silt loam, 7 to 11 percent slopes (CozC).—This soil is along intermittent drainageways. Areas are long and narrow and range from 10 to 40 acres in size.

This soil has a profile similar to the one described as representative for the series, but lime is at a greater depth. Included in mapping were small areas of Hobbs and Ortello soils and areas of severely eroded Cozad soils.

This soil is very friable. The hazard of water erosion is the principal concern in management. Surface runoff is rapid.

Most areas are in native grass and are used for range. Some areas are cultivated. Wheat is the main crop. Alfalfa, grain sorghum, and corn are also grown. This soil is suitable for trees and for use by wildlife. Capability units IVe–1 dryland and IVe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Cozad silt loam, terrace, 0 to 1 percent slopes (2Coz).—This deep soil formed in calcareous loess on stream terraces in the Platte River Valley. Areas are irregular in shape and range from 10 to 40 acres in size.

This soil has the profile described as representative for the Cozad series. Included in mapping were small areas of Slickspots, areas where the subsoil and parent material are fine sandy loam, and a few areas where the surface layer is very fine sandy loam and is thicker than the surface layer described in the representative profile.

This soil is easily tilled. It takes in water easily and releases it readily to plants. It is susceptible to soil blowing unless adequately protected. This soil is well suited to irrigation, but maintaining fertility and managing water are concerns in irrigated areas. Runoff is slow.

Most of the acreage is cultivated. Corn, grain sorghum, wheat, and alfalfa are the principal crops. Capability units I–1 dryland and I–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Cozad silt loam, terrace, 1 to 3 percent slopes (2CozA).—This soil is on stream terraces in the Platte River Valley. Areas are irregular in shape and range from 10 to 40 acres in size.

Included in mapping were small areas of Slickspots, a few areas where the subsoil is fine sandy loam, and small areas of soils that have a thicker surface layer than that of the representative profile.

Water erosion is a slight to moderate hazard. Soil blowing is a hazard unless the soil is protected by a crop or a cover of organic matter. Maintaining an adequate level of fertility is essential. This soil is easy to work and releases moisture readily to plants. Runoff is slow.

Most areas are cultivated. Corn, grain sorghum, wheat, and alfalfa are the chief crops. Only a few areas are in native grass. Wildlife use areas of this soil as a source of food. Capability units IIe–1 dryland and IIe–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Cozad silt loam, terrace, 3 to 7 percent slopes (2CozB).—This deep soil is on stream terraces in the Platte River Valley. Areas are irregular in shape and range from 5 to 40 acres in size.

This soil has a profile similar to the one described as representative for the series, but the surface layer is slightly thinner and lime is nearer the surface. Included in mapping were small areas of Slickspots and small areas where the subsoil and underlying material are fine sandy loam.

Water erosion is a hazard. Runoff is medium. Soil blowing is a hazard unless the soil is adequately protected. Maintaining fertility and managing water are concerns in irrigated areas.

Most areas are cultivated. Corn, grain sorghum, wheat, and alfalfa are the main crops. Only a few areas are in native grass. This soil is suited to irrigation if measures are provided for erosion control. It is suitable for windbreak plantings and for use by wildlife as shelter and a source of food. Capability units IIIe–1 dryland and IIIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Cozad soils, 3 to 7 percent slopes, severely eroded (CosB3).—These soils are along intermittent drainageways in the loess uplands. Areas are long and narrow and range from 20 to 80 acres in size.

These soils have a profile similar to the one described as representative for the series, but the soil material is less friable, the surface layer is thinner and lighter colored, and lime is at a greater depth. The texture of the surface layer ranges from silt loam to silty clay loam. Included in mapping were small areas of Hobbs and Holder soils.

Water erosion is a severe hazard in cultivated areas. Small gullies are numerous. Runoff is medium. The organic-matter content is low. Nitrogen, in particular, is in low supply. Tilth is only fair.

The entire acreage has been cultivated. Corn, grain sorghum, wheat, and alfalfa are the main crops. Some areas are now seeded to tame grasses. The soils are suitable for irrigation, but water management is particularly difficult, and fertility has to be improved. The soils are suitable for windbreak plantings and for use by wildlife. Capability units IIIe–8 dryland and IIIe–11 irrigated; Silty range site; Silty to Clayey windbreak group.

Cozad soils, 7 to 11 percent slopes, severely eroded (CosC3).—These soils are along intermittent streams in the loess uplands. Areas are long and narrow and range from 15 to 80 acres in size.

These soils have a profile similar to the one described as representative for the series, but they are less friable, the surface layer is thinner and lighter colored, and lime is at a greater depth. The surface layer ranges from silt loam to silty clay loam. Included in mapping were small areas of Hobbs and Holder soils.

Water erosion is the main hazard. Runoff is rapid, and small gullies are common. Fertility and the organic-matter content are low. The nitrogen content is low. Tilth is only fair.

The entire acreage has been cultivated. Some areas are now in tame grass and are used for pasture. Corn, grain sorghum, wheat, and alfalfa are the most commonly grown crops. These sloping soils are suited to irrigation, but water management is particularly difficult. The soils are suitable for windbreak plantings and for use by wildlife as shelter. Capability units IVe–8 dryland and IVe–11 irrigated; Silty range site; Silty to Clayey windbreak group.

Cozad-Slickspots complex, terrace (0 to 1 percent slopes) (CS).—These are nearly level soils on stream terraces in the Platte River Valley. About 70 percent of the acreage is Cozad silt loam, and the remaining 30 percent is Slickspots.

In cultivated areas, the Slickspots are lighter colored and more cloddy than the Cozad soil. In rangeland, Slickspots occur as small depressions, slightly lower than the Cozad soil.

The Cozad soil has a profile similar to the one described as representative for the series, but the underlying material is more alkaline.

Slickspots are described under the heading "Slickspots." The total acreage is small. The main concern in management is the salinity and alkalinity of these areas. Because of the alkali content, some nutrients are not available to plants. Cultivation is difficult. The surface layer puddles easily and crusts when dry. Establishing a good stand of most cultivated crops is difficult in the slickspot areas. Surface drainage is needed to facilitate tillage. Soil blowing is a hazard unless the surface is protected. Permeability is slow.

Most areas are cultivated. Some have been leveled and are irrigated. Corn, grain sorghum, and alfalfa are the crops commonly irrigated, and wheat is the most common dryland crop. A few areas are in native grass and are used for grazing. These soils are suitable for windbreak plantings and for use by wildlife. Capability units IIIs–1 dryland and IIs–1 irrigated; Silty Lowland range site; Cozad soil, Silty to Clayey windbreak group, and Slick-spots, Moderately Saline-Alkali windbreak group.

Darr Series

The Darr series consists of somewhat excessively drained soils that are moderately deep over mixed sand and gravel. These nearly level soils formed in loamy alluvium on the Platte River bottom land.

In a representative profile, the surface layer is fine sandy loam about 14 inches thick. It is gray in the upper part and dark gray in the lower part. The underlying material is light brownish-gray fine sandy loam in the upper part. At a depth of 25 inches, it is light-gray fine sand, and at a depth of 33 inches, it is mixed sand and gravel.

Darr soils have moderately rapid permeability and low available water capacity. Organic-matter content is moderately low, and natural fertility is medium. Soil reaction is neutral throughout the profile.

Most of the acreage is cultivated, and much of it is irrigated from wells. A few areas are in native grass and are used as range or mowed for hay.

Representative profile of Darr fine sandy loam in a cultivated field 50 feet north and 100 feet west of the southeast corner of sec. 24, T. 16 N., R. 2 W.:

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

A12—7 to 14 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; soft, very friable; neutral; clear, smooth boundary.

C1—14 to 25 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure; soft, very friable; neutral; clear, smooth boundary.

IIC2—25 to 33 inches, light-gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; few, fine and medium, distinct, yellowish-brown and dark reddish-brown mottles; single grain; loose; neutral; gradual, wavy boundary.

IIC3—33 to 60 inches, light-gray (10YR 7/2) mixed sand and gravel, light brownish gray (10YR 6/2) moist; single grain; loose.

The A horizon ranges from 8 to 16 inches in thickness. The C horizon is stratified in some places with medium-textured to coarse-textured material. Mixed sand and gravel is at a depth of 20 to 40 inches. The water table is at a depth of 6 to 15 feet.

Darr soils are near Cass, Alda, and Inavale soils. They are not so deep as Cass soils. They are better drained than Alda soils, have a darker colored A horizon, and are not so coarse textured in the upper part of the underlying material nor so deep.

Darr fine sandy loam (0 to 1 percent slopes) (Da).—This soil is moderately deep over mixed sand and gravel. It is on bottom lands of the Platte River Valley. Areas of this soil range from 10 to 40 acres in size.

Included in mapping were small areas of Cass and Alda soils and some areas where there are dark-colored layers of a buried soil in the underlying material.

Soil blowing is a hazard in cultivated areas. Runoff is slow. Improving fertility is a concern, particularly in irrigated areas. Sand and gravel in the lower part of the underlying material limit root growth. This soil is droughty in areas where crops are grown under dryland management.

Most areas are cultivated and are used for corn, grain sorghum, wheat, and alfalfa. The principal crops under irrigation are corn and grain sorghum. Only a few areas are in native grass. This soil is suitable for windbreak plantings. Wildlife use areas of this soil mainly as a source of food. Capability units IIe–3 dryland and IIe–3 irrigated; Sandy Lowland range site; Sandy windbreak group.

Fillmore Series

The Fillmore series consists of deep, poorly drained, nearly level soils that have a claypan subsoil. These soils formed in shallow upland depressions where the parent material is loess. They are subject to occasional flooding from the runoff of surrounding areas.

In a representative profile, the surface layer is gray silt loam about 9 inches thick. Beneath this is a light-gray silt loam subsurface layer about 5 inches thick (fig. 6). The boundary between this layer and the subsoil is abrupt. The subsoil is 28 inches thick. The upper part is gray silty clay, the middle part is dark grayish-brown silty clay, and the lower part is firm, grayish-brown silty clay loam. At a depth of 42 inches is pale-yellow silt loam.

Fillmore soils have slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is medium. The surface layer is slightly acid, and the subsoil is neutral.

Most of the acreage is cultivated; the rest is in native grass. These soils are suitable for irrigation if the flood hazard is removed.

Representative profile of Fillmore silt loam in a cultivated field 0.2 mile south and 75 feet east of the northwest corner of sec. 22, T. 13 N., R. 2 W.:

Ap—0 to 9 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, medium, granular structure; slightly hard, friable; slightly acid; clear, wavy boundary.

A2—9 to 14 inches, light-gray (10YR 7/1) silt loam, gray (10YR 6/1) moist; weak, thick, platy structure parting to weak, fine, granular; soft, friable; few shotlike pellets; slightly acid; abrupt, smooth boundary.

B21t—14 to 18 inches, gray (10YR 4/1) silty clay, very dark grayish brown (10YR 3/2) moist; strong, coarse, blocky structure parting to strong, fine to medium, blocky; very hard, very firm; many round shotlike pellets; shiny surfaces on peds; neutral; clear, smooth boundary.

B22t—18 to 34 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong, medium, prismatic structure parting to moderate, fine to medium, blocky; very hard, very firm; shiny surfaces on peds; neutral; clear, smooth boundary.

B3—34 to 42 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure; hard, firm; neutral; clear, smooth boundary.

C—42 to 60 inches, pale-yellow (2.5Y 7/4) silt loam, light yellowish brown (2.5Y 6/4) moist; few, fine, faint, yellowish-brown relic mottles; weak, coarse, prismatic structure; slightly hard, very friable; neutral; lime present but matrix is not calcareous.

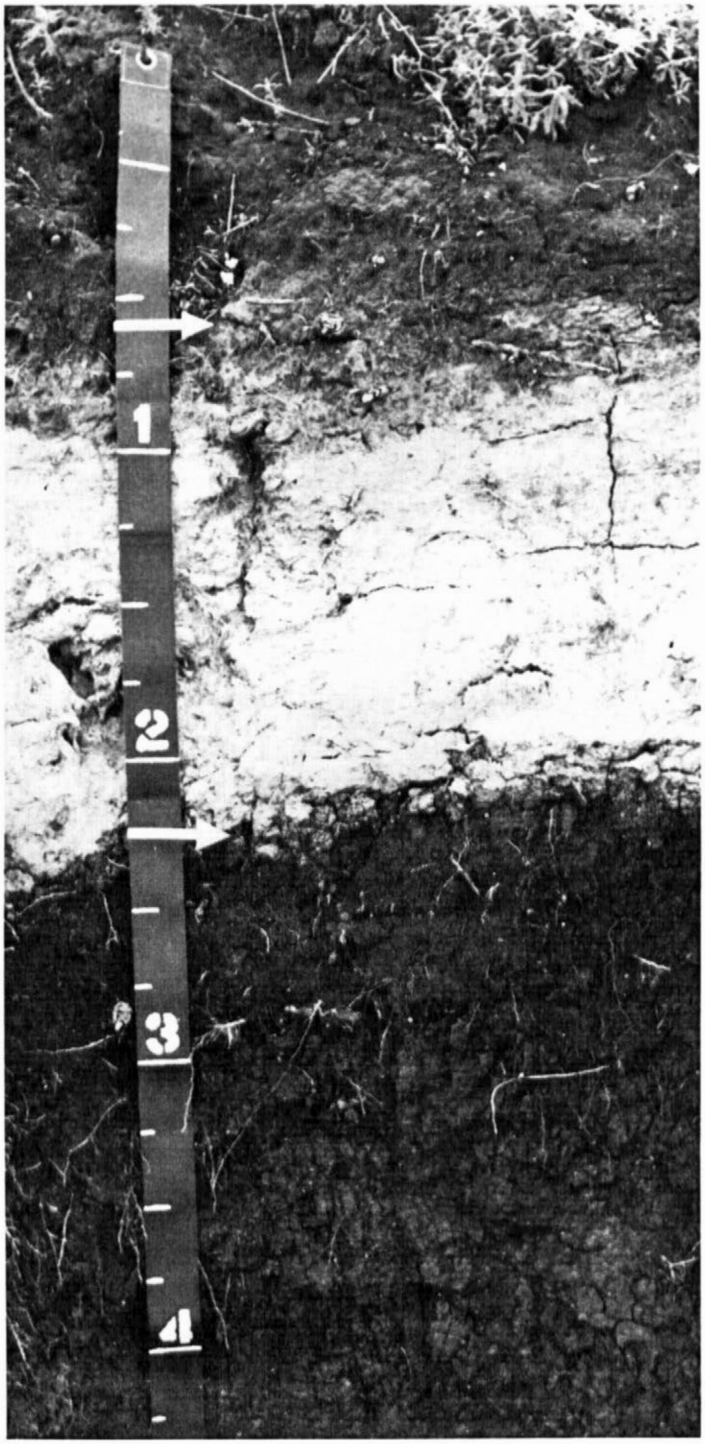

Figure 6.—**Profile of Fillmore silt loam showing distinct subsurface layer. This is a deep, poorly drained claypan soil that formed in shallow upland depressions.**

The A horizon ranges from 10 to 20 inches in thickness, and the A2 horizon from 4 to 15 inches. The solum ranges from 36 to 65 inches in thickness. The depth to lime typically ranges from 45 to 60 inches, but in some areas the soils are noncalcareous to a depth of 80 inches.

Fillmore soils are near Butler, Hastings, and Holder soils. They have a thicker A2 horizon than Butler soils and formed on lower parts of the landscape. They have a finer textured, darker colored B horizon than Hastings or Holder soils, and they formed on lower parts of the landscape. They differ from Hastings and Holder soils in having an A2 horizon.

Fillmore silt loam (0 to 1 percent slopes) (Fm).—This soil is in shallow depressions on the upland loess plains. Areas are round or oblong in shape and range from 3 to 120 acres in size. In cultivated areas, the surface layer is lighter colored than that of the surrounding soils. Runoff from adjacent areas occasionally ponds on this soil.

Included with this soil in mapping were areas of Butler, Hastings, and Holder soils and a few areas of soils that have a silty clay loam subsoil.

Ponding and flooding after a heavy rain are hazards. There are no natural outlets; therefore, there is little or no runoff. The slow permeability of the subsoil allows only a small amount of the ponded water to move through the solum. Most of the surface water is removed by evaporation. Planting and cultivation are commonly delayed. Crops can be drowned by excess water.

Wheat is the main dryland crop. Some grain sorghum and corn are also grown. Alfalfa is not so well suited as other crops. Only a few areas are still in native vegetation. This soil is suitable for trees and for use by wildlife. Capability units IIIw–2 dryland and IIs–21 irrigated; Clayey Overflow range site; Moderately Wet windbreak group.

Gravel Pits

Gravel pits (GP) occupies bottom lands of the Platte River Valley. It consists mainly of deep excavations from which the gravel has been removed. These pits are usually filled with water. Included in the areas mapped are numerous adjacent piles of sand. None of the acreage is suited to cropland, pasture, or woodland, but it can be used for wildlife and recreation. Many pits are stocked with fish. Capability unit VIIIs–1 dryland; no range site or windbreak group.

Hall Series

The Hall series consists of deep, well-drained, nearly level soils that formed on stream terraces in the Platte River Valley and the Big Blue River Valley.

In a representative profile, the surface layer is silt loam about 14 inches thick. The upper part is gray and the lower part is dark gray. The subsoil is firm silty clay loam about 22 inches thick. It is gray in the upper part and light brownish gray in the lower part. The underlying material is light-gray, friable silt loam.

Hall soils have moderately slow permeability and high available water capacity. They absorb water readily and release it readily to plants. The organic-matter content is moderate, and natural fertility is high. These soils are slightly acid in the surface layer.

These soils are well suited to cultivated crops. Nearly all areas are cultivated, and many of these are irrigated. Only a few areas are still in native grass. Hall soils are among the best soils in the county for farming.

Representative profile of Hall silt loam, 0 to 1 percent slopes, in a cultivated field 1,000 feet east and 70 feet south of the northwest corner of sec. 2, T. 15 N., R. 1 W.:

Ap—0 to 6 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, fine, granular structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

A12—6 to 14 inches, dark-gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak, coarse, subangular blocky structure parting to weak, fine, granular; slightly hard, friable; slightly acid; clear, smooth boundary.

B1—14 to 22 inches, gray (10YR 5/1) silty clay loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure; hard, firm; slightly acid; clear, smooth boundary.

B2t—22 to 36 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to moderate, fine, subangular blocky; hard, firm; slightly acid; clear, smooth boundary.

C—36 to 60 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; few, fine, faint, dark-brown mottles at a depth of 36 to 48 inches; weak, coarse, prismatic structure; slightly hard, friable; neutral.

The A horizon ranges from 10 to 19 inches in thickness and the B horizon from 10 to 24 inches. In some areas the lower part of the B horizon and the C horizon are calcareous. The C horizon ranges from medium textured to moderately coarse textured.

Hall soils are associated with Hord and Blendon soils. They have a finer textured B horizon than either Hord or Blendon soils.

Hall silt loam, 0 to 1 percent slopes (Ha).—This is a deep, well-drained soil that formed on stream terraces. The parent material is alluvium, loess, or a mixture of alluvium and loess. Areas are irregular in shape and range from about 10 to 100 acres in size.

Included in mapping were small areas of Hord and Blendon soils and a few areas of soils that have a silty clay subsoil.

Some areas of this soil are occasionally flooded for short periods after heavy rain, but the flooding seldom damages crops. The additional moisture can be beneficial. Runoff is slow. Soil blowing is a hazard unless the soil is protected. Inadequate rainfall is a hazard in the driest years in areas where cultivated crops are grown under dryland management.

Nearly all areas of this soil are cultivated. Corn, grain sorghum, wheat, and alfalfa are grown in dryland areas. Corn and grain sorghum are also grown in many irrigated areas, especially in the Platte River Valley. The soil is suited to trees and to use by wildlife. Capability units I–1 dryland and I–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Hastings Series

Hastings soils are deep, well-drained soils on uplands. These soils are nearly level to moderately sloping. They formed in loess.

In a representative profile (fig. 7), the surface layer is dark-gray silt loam 12 inches thick. The subsoil is silty clay loam 28 inches thick. It is brown in the upper part and pale brown in the lower part. At a depth of 40 inches is light yellowish-brown, very friable silt loam.

Hastings soils have moderately slow permeability and high available water capacity. The organic-matter content and the level of fertility depend on the degree of erosion.

These soils are well suited to both irrigated and dryland farming. Most areas are cultivated. A few are still in native grass, and some have been seeded to tame grasses. Hastings soils are some of the best in the county for cultivated crops.

Profile of Hastings silt loam, 0 to 1 percent slopes, in a cultivated field 250 feet east and 1,230 feet south of the northwest corner of sec. 19, T. 13 N., R. 2 W.:

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

A12—7 to 12 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, medium, subangular blocky structure; slightly hard, friable; slightly acid; clear, smooth boundary.

B2t—12 to 32 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak, medium, prismatic structure parting to moderate, fine, subangular blocky; thin continuous clay coatings on peds; hard, firm; neutral; clear, wavy boundary.

B3—32 to 40 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, firm; neutral; clear, wavy boundary.

C—40 to 60 inches, light yellowish-brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) moist; weak, coarse, prismatic structure; soft, friable; neutral.

The A horizon ranges from 6 to 14 inches in thickness, and the B horizon from 20 to 35 inches in thickness. The A horizon ranges from dark gray in uneroded areas to light brownish gray in severely eroded areas.

The soil described in the representative profile has carbonates below the depth of 60 inches, which is deeper than in the range defined for the series. This difference, however, does not alter its use or management. The soils in mapping units HnB3 and HnC3 have a surface layer that is thinner and lighter colored than in the range defined for the series, but these differences do not significantly alter their use and management.

Hastings soils are near Holder, Butler, and Fillmore soils. They have a finer textured B horizon than Holder soils. In contrast with Butler and Fillmore soils, they occupy a higher position on the landscape and are better drained, they do not have a gray A2 horizon, and their B horizon is not so fine textured.

Hastings silt loam, 0 to 1 percent slopes (Hs).—This well-drained soil is on the uplands. Areas are irregular in shape and range from 10 to 1,000 acres in size.

This soil has the profile described as representative for the series. Included with this soil in mapping were small areas of Fllmore and Butler soils and a few areas of Hastings silt loam, 1 to 3 percent slopes.

Surface runoff is slow. Water erosion is not a hazard, but soil blowing can occur unless the soil is protected. During years of subnormal rainfall, the soil can be droughty if dryfarmed. Leveling is needed in most areas to facilitate irrigation. Maintaining a high level of fertility is essential.

Nearly all areas are cultivated. Only a few small areas are in native grass. Principal crops are corn, grain sorghum, wheat, and alfalfa. This soil is well suited to irrigation, and much of it is irrigated with water from deep wells. The soil is well suited to trees. Wildlife use the areas as a source of food and some areas for shelter. Capability units I–1 dryland and I–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Hastings silt loam, 1 to 3 percent slopes (HsA).—This is a fertile, well-drained soil on uplands. Areas are irregular in shape and range from about 10 to 100 acres in size.

Figure 7.—**Profile of Hastings silt loam. This soil is suitable for cultivation and windbreak plantings.**

Included with this soil in mapping were small areas of Hastings silt loam, 0 to 1 percent slopes; small areas of Hastings silt loam, 3 to 7 percent slopes; small areas of eroded Hastings soils where the surface layer is thinner and lighter colored than typical, and small areas of Fillmore and Butler soils.

Surface runoff is slow. Water erosion is the main hazard. Soil blowing can occur unless the surface is protected. Conserving water and maintaining a high level of fertility are essential in management.

Nearly all areas are cultivated, and a few of these are irrigated. This soil is well suited to corn, grain sorghum, wheat, and alfalfa. It is well suited to windbreak planting. The areas are used by wildlife. Capability units IIe–1 dryland and IIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Hastings silt loam, 3 to 7 percent slopes (HsB).—This well-drained soil is along intermittent drainageways and on a few ridgetops in the uplands. Slopes are short. The upper part is convex, and the lower part is concave. Areas of this soil range from 5 to 50 acres in size. Areas along intermittent drainageways are long and narrow.

The profile of this soil is similar to the one described as representative for the series, but the surface layer and subsoil are slightly thinner. Included in mapping were small severely eroded areas where the surface layer is thinner and lighter colored, small areas of less sloping Hastings silt loam, and small areas of Hobbs and Holder soils.

Surface runoff is medium, and water erosion is a severe hazard. Conserving moisture and maintaining a high level of fertility are essential in management.

Most of the acreage is cultivated. Only a few acres are irrigated. Corn, grain sorghum, wheat, and alfalfa are the crops commonly grown. A few areas have been seeded to bromegrass and are used for pasture. The soil is suitable for windbreak plantings and for use by wildlife. Capability units IIIe–1 dryland and IIIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Hastings soils, 3 to 7 percent slopes, severely eroded (HnB3).—These well-drained soils are along intermittent drainageways and a few flowing streams. Areas are generally long and narrow and range from about 5 to 60 acres in size. Slopes are short.

These soils have a profile similar to the one described as representative for the series, but the surface layer is light brownish-gray silt loam in places and silty clay loam in others, and only about 5 inches thick. The upper part of the original surface layer has been removed, mainly by water erosion. The present surface layer is a mixture of the remaining part of the original surface layer and the upper part of the subsoil.

Included in mapping were small areas of Hobbs soils on the bottoms of drainageways and of uneroded Hastings and Holder soils.

Surface runoff is medium. Water erosion is a severe hazard. Both gully and sheet erosion are active. Controlling water erosion and conserving all of the available water are the main concerns in managing these soils. The nitrogen content is low, and the organic-matter content is low. Improving tilth and fertility is also an essential practice in management.

Nearly all areas are cultivated, and a few of these are irrigated. Wheat, grain sorghum, corn, and alfalfa are the main crops. A few areas are seeded to bromegrass and are used for pasture. These soils are suitable for trees and for use by wildlife. Capability units IIIe–8 dryland and IIIe-11 irrigated; Silty range site; Silty to Clayey windbreak group.

Hastings soils, 7 to 11 percent slopes, severely eroded (HnC3).—These well-drained soils are along intermittent drainageways. Slopes are short. The upper part of the slope is convex, and the lower part is concave. Areas are generally long and narrow and range from 5 acres to about 50 acres in size.

These soils have a profile similar to the one described as representative for the series, but the surface layer is thinner and lighter colored and is silt loam in some places and silty clay loam in others. The upper part of the original surface layer has largely been removed by erosion. The present surface layer is a mixture of the remaining part of the original surface layer and the upper part of the subsoil.

Included in mapping were small areas of Hobbs and Holder soils and a few small areas of uneroded Hastings soils.

Surface runoff is rapid, and water erosion is a severe hazard. Gullies are common. Conservation of water is also a concern. Because the soils are severely eroded, they are low in fertility. Nitrogen, in particular, is low, and the organic-matter content is low. Tilth is poor. Improving tilth, maintaining a high level of fertility, and conserving water are essential practices in management.

Most areas are cultivated. Wheat, grain sorghum, alfalfa, and corn are grown. Some areas have been seeded to bromegrass and are used for pasture. These soils are suitable for windbreak plantings. Wildlife use the areas as shelter and a source of food. Capability units IVe–8 dryland and IVe–11 irrigated; Silty range site; Silty to Clayey windbreak group.

Hobbs Series

The Hobbs series consists of deep, well drained and moderately well drained, medium-textured soils that formed in recent alluvium and colluvium on foot slopes, fans, and bottom land. These soils are nearly level to gently sloping. They are commonly stratified.

In a representative profile, the surface layer is silt loam about 20 inches thick. It is grayish brown in the upper part and dark gray in the lower part. Below this is a transitional layer of gray, friable silt loam 6 inches thick. The underlying material is very dark gray silt loam in the upper part and dark gray silt loam in the lower part. The lower part is faintly stratified with lighter colored soil material.

Hobbs soils are moderately permeable and have a high available water capacity. The organic-matter content is moderate, and natural fertility is high. Reaction is slightly acid in the surface layer and neutral in the rest of the profile.

Nearly all areas are cultivated, and some of these are irrigated. Some areas are still in native grass because they are too narrow to cultivate. Except where flooding or overflow is a hazard, these soils are suited to a wide range of crops and uses.

Representative profile of Hobbs silt loam, occasionally flooded, in a cultivated field 0.35 mile north and 300 feet east of the southwest corner of sec. 14, T. 13 N., R. 1 W.:

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

A12—8 to 20 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, coarse, blocky structure parting to weak, medium, granular; slightly hard, friable; slightly acid; clear, smooth boundary.

AC—20 to 26 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak, coarse, blocky structure parting to weak, fine, subangular blocky; slightly hard, friable; neutral; clear, smooth boundary.

A1b1—26 to 46 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; massive; soft, friable; neutral; clear, smooth boundary.

A1b2—46 to 60 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; faintly stratified with lighter colored (10YR 5/1 and 6/2) lenses and layers; massive; soft, friable; neutral.

In some areas Hobbs soils are not stratified. The A horizon ranges from 20 to 40 inches in thickness and from dark gray to grayish brown in color. Light and dark-colored stratified material is at the surface in some areas. The depth to lime is typically 40 to more than 60 inches, but in some areas the soil has a calcareous layer of recent deposition at the surface.

Hobbs soils are associated with Hastings, Holder, and Cozad soils. They have a coarser, darker colored B horizon than Hastings or Holder soils. They have a darker colored B horizon than Cozad soils. They are more stratified than any of the associated soils.

Hobbs silt loam, 0 to 3 percent slopes (HbA).—This medium-textured, well-drained soil is on foot slopes and alluvial fans.

Included with this soil in mapping were a few areas of soils that have layers of moderately coarse textured material in the surface layer and underlying material and large areas of soils that do not have the dark-colored layers of buried soils that are typical of Hobbs soils.

Runoff from higher areas can be a hazard on this soil. Erosion and deposition of sediment can occur unless the runoff is controlled. Replanting is needed if the water washes the soil away, or if young plants are covered by sediment. Surface runoff is slow or medium.

Most areas are cultivated. Corn, grain sorghum, wheat, and alfalfa are the crops commonly grown. A few areas are in the native grass. This soil is suitable for trees and for use by wildlife. Capability units IIe–1 dryland and IIe–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Hobbs silt loam, 3 to 7 percent slopes (HbB).—This well-drained soil formed in alluvium on foot slopes at the base of uplands and on alluvial fans at the base of breaks to the Platte River Valley.

Included in mapping were small areas where the surface layer and underlying material are moderately coarse textured and small areas of soils that have grayish-brown or light brownish-gray underlying material.

Water erosion and flooding are the main hazards on this soil. The moving water sometimes damages newly planted crops, and replanting is needed. The additional moisture absorbed, however, benefits dryland crops. Surface runoff is medium. Water does not remain on this soil for long periods. Maintaining a high level of fertility is essential in management.

Nearly all areas are cultivated, and a few of these are irrigated. Corn, grain sorghum, wheat, and alfalfa are the crops commonly grown. Only a few areas are in native grass. This soil is suited to trees that can be used by wildlife as a source of food. Capability units IIIe–1 dryland and IIIe–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Hobbs silt loam, occasionally flooded (0 to 1 percent slopes) (2Hb).—This nearly level, moderately well drained soil is on bottom land along intermittent drainageways. Areas are generally long and narrow. The soil is flooded for a short period after a rain.

This soil has the profile described as representative for the series. Included in mapping were small areas of soils that have moderately coarse textured layers and a few areas of very gently sloping Hobbs soils.

Excess water from flooding is the principal hazard. Minor flooding from rainfall of low intensity can be beneficial. Trash left by moving water is a hazard in some areas. This soil is friable and easy to work. Wetness delays planting, and flooding makes replanting necessary in some areas. Protection against flooding is needed in irrigated areas. Runoff is slow.

Most areas are cultivated. Corn, grain sorghum, and alfalfa are crops commonly grown. Grain sorghum is grown under irrigation. Capability units IIw–3 dryland and I–2 irrigated; Silty Overflow range site; Moderately Wet windbreak group.

Holder Series

This series consists of deep, well-drained soils in the loess uplands. These soils are nearly level to very gently sloping.

In a representative profile (fig. 8), the surface layer is dark grayish-brown silt loam about 14 inches thick. The subsoil is friable, light brownish-gray light silty clay loam about 17 inches thick. At a depth of 31 inches is very friable, very pale brown silt loam.

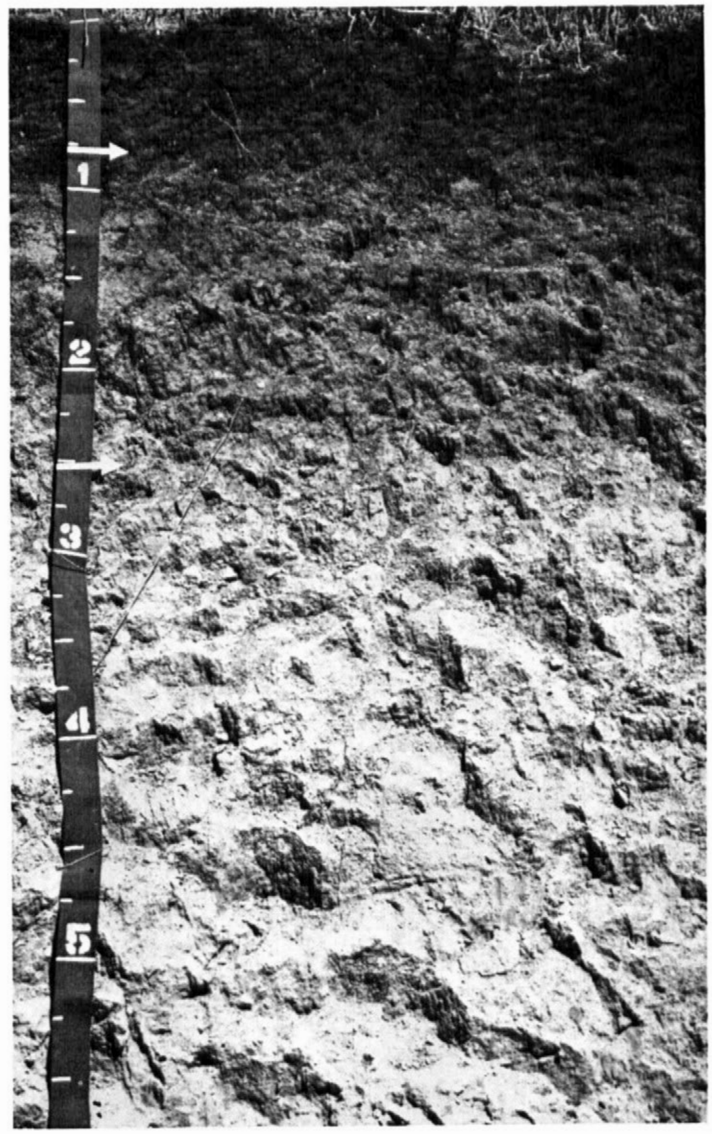

Figure 8.—**Profile of Holder silt loam, a deep soil on loess uplands. This soil is easy to work. Nearly all the acreage is cultivated.**

Holder soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. Reaction is slightly acid in the surface layer.

Nearly all areas are cultivated. Tilth is easy to maintain. These soils are well suited to irrigation, and many are irrigated from deep wells. They are suited to all crops commonly grown in the county. Holder soils are among the best in the county for farming.

Representative profile of Holder silt loam, 0 to 1 percent slopes, in a cultivated field 0.4 mile east and 50 feet north of the southwest corner of sec. 25, T. 15 N., R. 1 W.:

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

A12—7 to 11 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium blocky structure; soft, very friable, slightly acid; clear, smooth boundary.
A3—11 to 14 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; slightly hard, friable; slightly acid; clear, smooth boundary.
B21t—14 to 20 inches, light brownish-gray (10YR 6/2) light silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure; hard, friable; neutral; dark coatings on ped faces; clear, smooth boundary.
B22t—20 to 31 inches, light brownish-gray (10YR 6/2) light silty clay loam, grayish brown (10YR 5/2) moist; moderate, medium, subangular blocky structure; hard, friable; neutral; clear, smooth boundary.
C—31 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak, coarse, prismatic structure; soft, very friable; neutral.

The A horizon ranges from 7 to 18 inches in thickness, and the B horizon from 12 to 24 inches. The depth to carbonates ranges from 45 to more than 60 inches.

Holder soils are associated with Hastings, Fillmore, Butler, and Coly soils. They have less clay in the B horizon than Hastings, Fillmore, or Butler soils. Their B horizon is lighter colored than that in the Fillmore or Butler soils, and they do not have the gray A2 horizon that is typical of those soils. They have a finer textured, thicker A horizon than Coly soils, and all horizons are more distinct.

Holder silt loam, 0 to 1 percent slopes (Hg).—This is a deep, well-drained soil in the loess uplands. Areas are irregular in shape and range from 10 to more than 1,000 acres in size.

This soil has the profile described as representative for the series. Included in mapping were small areas of Hastings and Fillmore soils and areas of the very gently sloping Holder soils.

Soil blowing can be a hazard unless the surface layer is protected. Lack of adequate moisture in some years damages crops grown under dryland management. Water erosion is generally not a hazard. Maintaining fertility and managing water are practices needed in irrigated areas. Some land leveling is needed also. Runoff is slow.

This is one of the best soils under cultivation in the county. Almost all areas are cultivated, and many of these are irrigated with water from wells. Corn, grain sorghum, wheat, and alfalfa are the main dryland crops grown, and corn and grain sorghum are the main irrigated crops. Only a very small acreage is still in native grass. This soil is well suited to trees and to use by wildlife. Capability units I–1 dryland and I–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Holder silt loam, 1 to 3 percent slopes (HgA).—This deep, well-drained soil is in the loess uplands. Areas are irregular in shape and range from 10 to 100 acres in size.

This soil has a profile similar to the one described as representative for the series, but its surface layer is generally 2 or 3 inches thinner. Included in mapping were small areas of nearly level Holder soils and Fillmore soils and areas of gently sloping Cozad soils.

Water erosion is the main hazard. Runoff is medium. Conserving surface water, especially in dryland areas, and maintaining fertility are essential in management.

Nearly all areas are cultivated, and some of these are irrigated. Corn, grain sorghum, wheat, and alfalfa are the main crops grown. Only a few small areas are still in native grass. The soil is suitable for windbreak plantings and for use by wildlife. Capability units IIe–1 dryland and IIe–1 irrigated; Silty range site; Silty to Clayey windbreak group.

Hord Series

The Hord series consists of deep, well-drained, medium-textured soils. These nearly level soils formed in alluvium on stream terraces in the Platte River Valley and the Blue River Valley.

In a representative profile, the surface layer is silt loam about 16 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The subsoil is grayish-brown silt loam and loam and is 24 inches thick. At a depth of 40 inches is very friable, light brownish-gray very fine sandy loam.

Hord soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. Reaction is neutral in the surface layer.

Almost all areas are cultivated, and many of these are irrigated. Only a few small areas are still in native grass. Hord soils are among the best soils in the county for cultivated crops.

Representative profile of Hord silt loam, 0 to 1 percent slopes, in a cultivated field 800 feet west of the center of sec. 34, T. 16 N., R. 1 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium and fine, granular structure; slightly hard, friable; neutral; abrupt, smooth boundary.
A12—7 to 16 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; slightly hard, friable; neutral; clear, smooth boundary.
B2—16 to 30 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; slightly hard, friable; neutral; clear, smooth boundary.
B3—30 to 40 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; slightly hard, friable; neutral; clear, smooth boundary.
C—40 to 60 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure; soft, very friable; neutral.

The A horizon ranges from 10 to 19 inches in thickness and the B horizon from 12 to 30 inches. The underlying material is very fine sandy loam or silt loam but commonly contains layers of fine sandy loam. In some areas dark-colored layers of a buried soil are common in the underlying material.

Hord soils are associated with Hall, Blendon, and Thurman soils. They have less clay in the B horizon than Hall soils and are not so coarse textured as Blendon or Thurman soils.

Hord silt loam, 0 to 1 percent slopes (Hd).—This deep soil formed in alluvium on stream terraces. Areas are irregular in shape and range from 10 to 80 acres in size.

Included in mapping were small areas of Hall and Blendon soils and a few areas of soils that have a fine sandy loam surface layer.

Hazards on this soil are few. The soil blows unless it is protected. Maintaining fertility is essential, particularly in irrigated areas.

Nearly all the acreage is cultivated. The soil is excellent for irrigation. Corn, grain sorghum, wheat, and alfalfa crops are grown. This soil is suitable for windbreak plantings. It is used by wildlife for shelter and as a source of food. Capability units I–1 dryland and I–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Inavale Series

The Inavale series consists of deep, excessively drained soils that formed in sandy alluvium on the Platte River bottom land. These soils are nearly level to gently sloping.

In a representative profile, the surface layer is grayish-brown loamy fine sand about 11 inches thick. Beneath this is a transitional layer of light brownish-gray loamy fine sand 9 inches thick. At a depth below 20 inches is light-gray loose loamy sand and loose white sand.

Inavale soils have rapid permeability and low available water capacity. The organic-matter content is low, and natural fertility is low. The surface layer is neutral in reaction.

Most areas are in native grass and are grazed. A few areas are cultivated, and some of these are irrigated.

Representative profile of Inavale loamy fine sand, 0 to 3 percent slopes, in native grass 250 feet west and 20 feet north of the southeast corner of sec. 28, T. 16 N., R. 2 W.:

A—0 to 11 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak, coarse, granular structure parting to single grain; soft, very friable; neutral; clear, smooth boundary.

AC—11 to 20 inches, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; single grain; loose; neutral; clear, smooth boundary.

C1—20 to 53 inches, light-gray (10YR 7/2) loamy sand, light brownish gray (10YR 6/2) moist; stratified with lenses of very fine sandy loam in the lower part; single grain; loose; neutral; abrupt, smooth boundary.

C2—53 to 60 inches, white (10YR 8/2) sand, light gray (10YR 7/2) moist; single grain; loose; neutral.

The A horizon ranges from 4 to 14 inches in thickness. Structure is weak, granular, or single grain. Where this horizon is thinnest, it ranges from light brownish gray to dark grayish brown. The C horizon ranges from loamy sand to coarse sand. In places it is stratified with lenses of loamy soil material.

Inavale soils are associated with Cass, Wann, Platte, and Alda soils. They are coarser textured than Cass soils. They are coarser textured and have a lower water table than Wann soils. They are deeper and have a lower water table than Platte and Alda soils.

Inavale loamy fine sand, 0 to 3 percent slopes (Ig).—This is a deep, coarse-textured soil on bottom land. Areas are long and narrow and range from 10 to 40 acres in size.

This soil has the profile described as representative for the series. Included in mapping were small areas of Meadin, Darr, and Platte soils.

Soil blowing is a hazard unless this soil is adequately protected by plant cover. Runoff is slow because most of the water from rainfall is absorbed almost as rapidly as it falls. In cultivated areas under dryland management, this soil is droughty. It releases moisture readily to plants, but tends to lose much of it through deep percolation. Increasing the supply of organic matter and improving fertility are needed practices in management.

Most of the acreage is in native grass and is used for range or hay. A few cultivated areas are used for wheat, grain sorghum, corn, and alfalfa. Only a few acres are irrigated. This soil is suitable for trees and for use by wildlife. Capability units IIIe–5 dryland and IIIe–5 irrigated; Sands range site; Sandy windbreak group.

Inavale loamy sand, 3 to 7 percent slopes (IbB).—This deep soil is mainly on long, narrow ridges of bottom land near the Platte River. Areas range from 10 to 40 acres in size.

This soil has a profile similar to the one described as representative for the series, but the surface layer is loamy sand. Included in mapping were small areas of Meadin, Darr, and Platte soils and a few areas of Inavale soils that are slightly steeper than this soil.

Soil blowing is a hazard unless adequate cover is maintained. There are blowouts in some areas. Runoff is slow because nearly all the rainwater enters the soil as rapidly as it falls. Under dryland management this soil is droughty. Both fertility and the organic-matter content have to be improved. The soil can be cultivated soon after a rain, and it releases moisture readily to plants. Keeping this soil in good tilth is difficult, because it is so coarse textured.

Almost all the acreage is in native grass and is used for range or hay. Only a few acres are cultivated. Close-growing crops are well suited, and trees are suited. Areas of this soil are used by some wildlife for protection and as a source of food. Capability unit IVe–51 dryland; Sands range site; Sandy windbreak group.

Inavale-Platte complex (0 to 7 percent slopes) (IP).—This mapping unit is about 70 percent Inavale loamy sand, 3 to 7 percent slopes, and 25 percent Platte fine sandy loam. Inavale soil is at the higher elevations, on low ridges 3 to 10 feet above the level of the Platte soil. The nearly level Platte soil is at the lowest elevations.

These soils have profiles similar to the ones described as representative for their respective series. Included with them in mapping were a few small areas of Alda soils.

Soil blowing is a hazard on the Inavale soil unless it has an adequate vegetative cover. The alternating ridges and swales make cultivation difficult. Under dryland management, the soils are droughty. There are also other hazards that make these soils marginal for cultivated crops. The soils are more suitable for grazing than for other uses. Trees can be grown for windbreaks, and some wildlife use the areas for shelter and as a source of food.

These soils are in native grass and are used for range and hay. They are suited to trees and to use by some kinds of wildlife. Capability unit IVe–51 dryland; Inavale soil, Sands range site and Sandy windbreak group; Platte soil, Subirrigated range site and Moderately Wet windbreak group.

Lamo Series

The Lamo series consists of deep, somewhat poorly drained, nearly level soils. These soils formed in loamy alluvium on bottom land of the Platte River Valley.

In a representative profile, the surface layer is very dark gray silty clay loam about 14 inches thick. Beneath this is a transitional layer of dark-gray, calcareous silty clay loam 6 inches thick. The underlying material is gray silty clay loam in the upper part and gray loam and light-gray very fine sandy loam in the middle part. At a depth of 42 inches is mixed sand and gravel.

Lamo soils have moderately slow permeability and high available water capacity. The organic matter content is moderate, and natural fertility is medium. Reaction is moderately alkaline in the surface layer. The water table is 2 to 6 feet beneath the surface. It fluctuates from season to season. It is highest late in fall or early in spring and lowest late in summer at the end of the growing season.

Most of the acreage is cultivated, and some of this is irrigated. Some areas are still in native grass and are used for range and hay. These soils are well suited to grass because they are subirrigated. During periods of limited rainfall, dryland crops benefit from the water table.

Representative profile of Lamo silty clay loam, sandy substratum, in a cultivated field 0.5 mile south and 50 feet west of the northeast corner of sec. 11, T. 16 N., R. 1 W.:

Ap—0 to 7 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak, medium, granular structure; hard, friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A12—7 to 14 inches, very dark gray (10YR 3/) silty clay loam, black (10YR 2/1) moist; weak, medium, blocky structure parting to moderate, medium, granular; hard, firm; calcareous; moderately alkaline; clear, smooth boundary.

AC—14 to 20 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak, medium, subangular blocky structure parting to moderate, medium to fine, granular; hard, firm; calcareous; moderately alkaline; clear, smooth boundary.

C1—20 to 29 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; few, fine, faint, brownish-yellow mottles; moderate, medium, prismatic structure parting to moderate, medium and fine, subangular blocky; hard, firm; calcareous; moderately alkaline; few snail shells; clear, smooth boundary.

C2—29 to 34 inches, gray (10YR 6/1) loam, dark gray (10YR 4/1) moist; few, fine, faint, brownish-yellow mottles; weak, coarse, subangular blocky structure; slightly hard, friable; calcareous; moderately alkaline; gradual, smooth boundary.

C3—34 to 42 inches, light-gray (10YR 7/2) very fine sandy loam, light brownish gray (2.5Y 6/2) moist; common, medium, distinct, yellowish-brown mottles; massive; slightly hard, friable; neutral; gradual, smooth boundary.

IIC4—42 to 60 inches, very pale brown (10YR 8/3) mixed sand and gravel, light gray (10YR 7/2) moist; few, medium, distinct, yellowish-brown mottles; single grain; loose; neutral; water table at a depth of 42 inches.

The A horizon ranges from 10 to 20 inches in thickness. The C horizon is stratified in the lower part with clayey, loamy, and sandy material. The depth to sand and gravel ranges from 40 to 72 inches. Carbonates are within a depth of 10 inches.

Lamo soils are near Leshara, Wann, Cass, and Inavale soils. They are finer textured than Leshara or Wann soils. They have a higher water table and are finer textured than Cass or Inavale soils.

Lamo silty clay loam, sandy substratum (0 to 1 percent slopes) (2Lb).—This nearly level, somewhat poorly drained soil is on bottom land in the Platte River Valley. Areas are irregular in shape and range from 10 to 100 acres in size.

Included in mapping were small areas of Leshara, Wann, and Alda soils and a few areas where sand and gravel is at a depth of 20 to 40 inches.

Excessive wetness is a common hazard at planting time in spring because the water table is high. Flooding can occur for short periods following heavy rain. Late in summer, however, when rainfall is commonly inadequate for dryland farming, crops benefit from the water table.

Most areas of Lamo soils are cultivated. Corn, grain sorghum, and alfalfa are grown under dryland management. Corn and grain sorghum are also grown under irrigation. Most uncultivated areas are in native grass and are used for range or hay. This soil is suitable for windbreak plantings. Wildlife use the areas for protection and as a source of food. Capability unit IIw-4 dryland and IIw-4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Leshara Series

The Leshara series consists of deep, somewhat poorly drained soils (fig. 9). These nearly level soils developed in loamy alluvium on bottom land in the Platte River Valley.

Figure 9.—**Profile of Leshara silt loam, a somewhat poorly drained soil on bottom land in the Platte River Valley.**

In a representative profile, the surface layer is dark-gray silt loam about 21 inches thick. It is calcareous in the lower part. The underlying material is light brownish-gray, mottled, friable silt loam to a depth of 49 inches and light-gray sandy loam below.

Leshara soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is medium. The surface layer is neutral in reaction. Except in drained areas, the water table fluctuates between depths of 2 and 6 feet. It is highest late in fall and early in spring and lowest late in summer. During the fall season in some areas, capillary action brings soluble salts to the surface. The salts accumulate as a white crust on the surface, but little damage occurs because they are washed away by rain or irrigation water. The water table is beneficial to dryland crops late in fall when normal precipitation is lowest.

Most areas of Leshara soils are cultivated, and some of these are irrigated with water from wells. Uncultivated areas are mostly in native grass and are used for range or hay.

Representative profile of Leshara silt loam in a cultivated field 0.5 mile west and 50 feet north of the southeast corner of sec. 22, T. 16 N., R. 1 W.:

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

A12—7 to 13 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak, coarse, blocky structure parting to moderate, fine, granular; slightly hard, friable; neutral; clear, smooth boundary.

A3—13 to 21 inches, dark-gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard, friable; calcareous; neutral; clear, smooth boundary.

C—21 to 46 inches, light brownish-gray (2.5YR 6/2) silt loam, grayish brown (2.5Y 5/2) moist; few, fine, faint, brownish-yellow mottles; weak, coarse, blocky structure; slightly hard, friable; calcareous; moderately alkaline; few small lime concretions; abrupt, smooth boundary.

Ab—46 to 49 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; few, fine, faint, olive-yellow mottles; moderate, medium to coarse, blocky structure; hard, firm; calcareous; moderately alkaline; clear, smooth boundary.

C—49 to 60 inches, light-gray (10YR 6/1) sandy loam, gray (10YR 5/1) moist; massive; soft, very friable; mildly alkaline; water table at a depth of 60 inches.

The A horizon ranges from 13 to 22 inches in thickness. In some areas the C horizon is stratified with moderately fine, medium, or moderately coarse textured soil material. Dark-colored layers of a buried soil are common in areas of Leshara soils. The depth to lime ranges from 12 to 20 inches. In mapping unit 2Le the water table is lower than is defined in the range for the series, but this difference does not alter the use or behavior of this soil.

Leshara soils are near Lamo, Wann, Platte, and Alda soils. They are not so coarse textured as Wann soils nor so fine textured as Lama soils. They are deeper over sand and gravel than Platte and Alda soils.

Leshara silt loam (0 to 1 percent slopes) (Le).—This deep, somewhat poorly drained soil formed in loamy alluvium on bottom land. Areas are irregular in shape and range from 10 to 100 acres in size.

This soil has the profile described as representative for the series. Included in mapping were small areas of Alda, Lamo, and Wann soils and a few Slickspots.

Runoff is slow. Wetness is a hazard in spring because the water table is highest at this time of year. Wetness delays planting and tillage. In most areas a small amount of land leveling is needed before gravity irrigation can be used. Maintaining fertility is essential.

Most areas are cultivated. Corn, grain sorghum, and alfalfa are the crops commonly grown. Irrigated areas are used mainly for corn and grain sorghum. Uncultivated areas are generally in native grass and are used for grazing or hay. Capability units IIw–4 dryland and IIw–4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Leshara silt loam, drained (0 to 1 percent slopes) (2Le).—This nearly level, deep soil formed in alluvium at some of the highest elevations of the bottom land. Areas are irregular in shape and range from 10 to 100 acres in size.

This soil has a profile similar to the one described as representative for the Leshara series, but the water table fluctuates between depths of 6 and 10 feet. Included with this soil in mapping were small areas of Cass and Darr soils and small areas of soils that are medium textured and are moderately deep over mixed sand and gravel.

This soil is subject to soil blowing unless the surface is adequately protected. It is easy to work. It absorbs moisture well and releases it readily to plants. Surface runoff is slow. Fertility has to be maintained. Some land leveling is needed if the soil is to be gravity irrigated.

This is an excellent soil for cultivated crops, and nearly all areas are cultivated. Corn, grain sorghum, wheat, and alfalfa are grown, and many of these are irrigated. The soil is well suited to windbreak plantings. Wildlife use areas of this soil as a source of food. Capability units I–1 dryland and I–1 irrigated; Silty Lowland range site; Silty to Clayey windbreak group.

Meadin Series

The Meadin series consists of excessively drained soils (fig. 10). These soils are nearly level to gently sloping and are on the higher bottom land and stream terraces in the Platte River Valley. They are shallow over mixed sand and gravel.

In a representative profile, the surface layer is dark grayish-brown, very friable loamy sand about 11 inches thick. Below this is a transitional layer of grayish-brown, loose loamy sand about 6 inches thick. At a depth of 17 inches is light-gray mixed sand and gravel.

Meadin soils have rapid permeability and very low available water capacity. The organic-matter content and natural fertility are low. Reaction is slightly acid in the surface layer. Percolation of water is moderately rapid because the soil is coarse textured and only a small amount of moisture is retained for plant use.

Nearly all the acreage is native grassland and is used for grazing. These soils are not suitable for cultivation because they are too coarse textured and droughty. A few formerly cultivated areas have reverted to native grasses. Some have been reseeded.

Representative profile of Meadin loamy sand, 0 to 5 percent slopes, in native grass 1,400 feet west and 50 feet north of the southeast corner of sec. 29, T. 16 N., R. 1 W.:

A—0 to 11 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark gray (10YR 3/1) moist; weak, medium and coarse, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

AC—11 to 17 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak, coarse, blocky structure; loose; slightly acid; clear, wavy boundary.

IIC—17 to 60 inches, light-gray (10YR 7/2) mixed sand and gravel, light brownish gray (10YR 6/2) moist; single grain; loose.

The A horizon ranges from 6 to 12 inches in thickness and from very dark gray to grayish brown in color. The depth to sand and gravel ranges from 10 to 20 inches.

Meadin soils occur near O'Neill, Thurman, and Platte soils. They are shallower over sand and gravel than O'Neill soils. Compared with Thurman soils, they are shallower and the underlying material is sand and gravel instead of loamy sand. Meadin soils have a lower water table than Platte soils.

Meadin loamy sand, 0 to 5 percent slopes (MdB).—This shallow soil is on the higher bottom land and stream terraces. Areas are irregular in shape and range from about 5 to 300 acres in size.

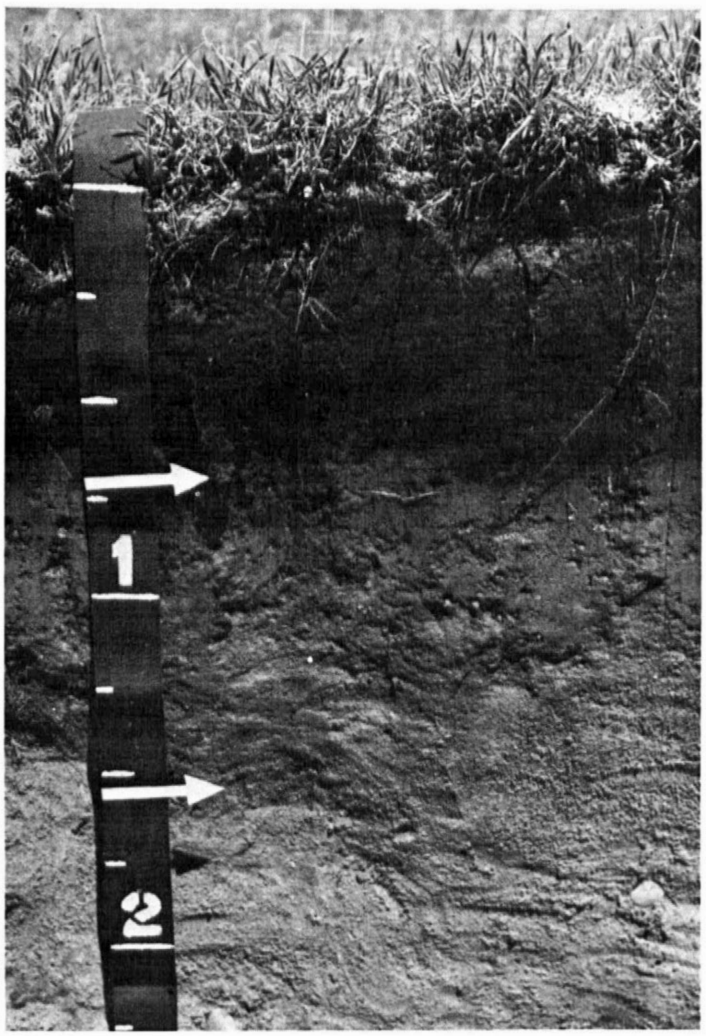

Figure 10.—Profile of Meadin loamy sand. This soil is droughty. The underlying material is mixed sand and gravel, and the available water capacity is very low.

Included in mapping were small areas of O'Neill and Thurman soils and areas of soils that have a sandy loam surface layer but are otherwise similar to Meadin soils.

Soil blowing is a hazard unless cover is adequate. The soil is droughty. Root development is limited because the soil is shallow over mixed sand and gravel. Water from rainfall is readily absorbed, and runoff is slow.

Nearly all the acreage is native grassland and is used for grazing. Only a few areas have been cultivated. These have been either reseeded to grass or left to revegetate. Certain kinds of trees can be grown as windbreaks. A few wildlife use the areas for protection and as a source of food. Capability unit VIs-4 dryland; Shallow to Gravel range site; Shallow windbreak group.

O'Neill Series

The O'Neill series consists of moderately coarse textured soils that are moderately deep over mixed sand and gravel. These soils are nearly level and well drained. They formed in alluvium on stream terraces in the Platte River Valley.

In a representative profile, the upper part of the surface layer is dark-gray fine sandy loam about 6 inches thick. The lower part is dark grayish-brown fine sandy loam about 9 inches thick. The subsoil is brown, very friable sandy loam about 5 inches thick. The underlying material is pale-brown very friable loamy sand in the upper part. At a depth of 31 inches it is very pale brown mixed sand and gravel.

O'Neill soils have moderately rapid permeability and low available water capacity. The organic-matter content is moderately low, and natural fertility is medium. Reaction is slightly acid in the surface layer.

These soils are used for grazing and cultivated crops. Most areas are in native grass. Some areas are irrigated with water from wells.

Representative profile of O'Neill fine sandy loam, 0 to 1 percent slopes, in native grass 1,980 feet south and 50 feet east of the northwest corner of sec. 31, T. 16 N., R. 1 W.:

A11—0 to 6 inches, dark-gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak, medium to coarse, granular structure; soft, very friable; slightly acid; clear, wavy boundary.

A12—6 to 15 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, coarse, blocky structure parting to weak, fine, granular; soft, very friable; slightly acid; gradual, wavy boundary.

B—15 to 20 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak, coarse, blocky structure parting to weak, medium, granular; soft, very friable; slightly acid; clear, wavy boundary.

C1—20 to 31 inches, pale-brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) moist; weak, medium, blocky structure; soft, very friable; medium acid; clear, wavy boundary.

IIC2—31 to 60 inches, very pale brown (10YR 7/3) mixed sand and gravel, pale brown (10YR 6/3) moist; few, fine, faint, brownish mottles in the lower part; single grain; loose; slightly acid.

The A horizon ranges from 7 to 19 inches in thickness. The C horizon ranges from sandy loam to gravelly loamy sand. The depth to the IIC horizon ranges from 20 to 40 inches.

O'Neill soils are near Meadin, Thurman, and Blendon soils. They have a thicker solum than Meadin soils. They are not so deep as Blendon or Thurman soils.

O'Neill fine sandy loam, 0 to 1 percent slopes (On).—This moderately deep soil is on stream terraces in the Platte River Valley.

Included in mapping were small areas of Meadin and Thurman soils and a few areas of soils that have a surface layer of loamy fine sand, but are otherwise similar to O'Neill soils.

Soil blowing is a hazard unless adequate cover is maintained. Crop roots do not penetrate the underlying sand and gravel. The soil is droughty in cultivated areas under dryland management. Careful water management is needed where the soil is irrigated. Surface runoff is slow.

Most of the acreage is in native grass and is used for grazing. Some areas are cultivated to corn, grain sorghum, alfalfa, and small grain. A few such areas are irrigated. Under improved management, irrigation provides greatly increased returns from this soil. Trees can be grown as windbreaks. Some wildlife use the areas for shelter and as a source of food. Capability units IIe–3 dryland and IIe–3 irrigated; Sandy range site; Sandy windbreak group.

Ortello Series

The Ortello series consists of deep, well-drained, moderately coarse textured soils. These soils are moderately sloping. They formed in wind-deposited material where the uplands break to the Platte River Valley.

In a representative profile, the surface layer is dark-gray fine sandy loam about 10 inches thick. The subsoil is very friable, grayish-brown fine sandy loam about 8 inches thick. The underlying material is pale-brown fine sandy loam.

Ortello soils have moderately rapid permeability and high available water capacity. Organic-matter content is low to moderately low. Natural fertility is medium. Reaction is neutral in the surface layer.

Most of the acreage is in native grass and is used for range or hay. Only a few acres are cultivated.

Representative profile of Ortello fine sandy loam in an area of Ortello complex, 7 to 11 percent slopes, in native grass 0.35 mile east and 0.1 mile north of the southwest corner of sec. 17, T. 14 N., R. 4 W.:

A—0 to 10 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; moderate, fine, blocky structure; slightly hard, very friable; neutral; clear, smooth boundary.

B—10 to 18 inches, grayish-brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure; slightly hard, very friable; neutral; clear, smooth boundary.

C—18 to 60 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; moderate, medium, blocky structure; soft, very friable; mildly alkaline.

The A horizon ranges from 6 to 18 inches in thickness and from silt loam to fine sandy loam in texture. The lower part of the C horizon ranges from silt loam to fine sandy loam or loamy fine sand.

Ortello soils are associated with Coly, Cozad, and Hobbs soils. They are coarser textured than any of those soils.

Ortello complex, 7 to 11 percent slopes (OrC).—This mapping unit is about 70 percent Ortello soils that have a surface layer of silt loam to loamy fine sand; and 30 percent soils that have a surface layer 20 to 30 inches thick, but are otherwise similar to Ortello soils; soils that formed in reddish-brown loess; and Hobbs soils at the bottoms of drainageways. These soils are on upland breaks to the Platte River Valley. Upper slopes are convex, and lower slopes are concave.

Ortello soils have the profile described as representative for the Ortello series, but the texture of the surface layer ranges widely. The Hobbs soil has the profile described as representative for the Hobbs series, but the surface layer is slightly more sandy in some places.

Erosion by water is the principal hazard. Runoff is rapid, and gullies are common. Soil blowing is a hazard in areas that are inadequately protected. This soil is easy to work. It releases moisture readily to plants.

Most areas are in native grass and are used for grazing. A few areas are mowed for hay. Only a small acreage is used for cultivated crops, mainly wheat, grain sorghum, alfalfa, and spring-sown grain. All are grown under dryland management. These soils are suited to windbreak plantings. Wildlife use areas of these soils for protection and as a source of food. Capability units IVe–3 dryland and IVe–3 irrigated; Sandy range site; Sandy windbreak group.

Ortello complex, 7 to 11 percent slopes, eroded OrC2).—This mapping unit is about 70 percent eroded Ortello soils that have a surface layer that is mainly very fine sandy loam but ranges to silt loam or loamy fine sand, and 30 percent soils that have a surface layer 20 to 30 inches thick, but are otherwise similar to Ortello soils. All are on upland breaks to the Platte River Valley. Upper slopes are convex, and lower slopes are concave. Areas are irregular in shape and range from 10 to 40 acres in size.

Ortello soils have a profile similar to the one described as representative for the series, but the surface layer is thinner and redder. In cultivated areas, the surface layer is a mixture of the remaining original surface layer and the original subsoil and is commonly brown or reddish brown.

Water erosion is the main hazard. Control of surface water is a serious concern. Runoff is rapid. Small gullies are common. Soil blowing is a hazard unless the soil is adequately covered with growing crops, grass, or organic matter. Increasing the level of fertility and the supply of organic matter is essential in management.

Most areas are cultivated or have been cultivated. Many are seeded to grass and used for grazing. These soils are suited to trees and to use by wildlife. Capability units IVe–3 dryland and IVe–3 irrigated; Sandy range site; Sandy windbreak group.

Ortello-Coly complex, 11 to 31 percent slopes (OxD).—This mapping unit is about 60 percent Ortello soils and 25 percent Coly soils. Areas are irregular in shape and range from 10 to 40 acres in size.

These soils have profiles similar to those described as representative for their respective series. Included in mapping were areas of soils that have a surface layer 20 to 30 inches thick, but are otherwise similar to Ortello soils; small areas of reddish-brown soils; and small areas of Hobbs soils at the bottoms of drainageways.

Erosion by water is a severe hazard. Runoff is rapid. Deep gullies are common in some areas. Conservation of surface water is needed.

Nearly all the acreage is in native range and is used for grazing. These soils are not suited to cultivation because they are too steep and the erosion hazard too severe. They are suited to windbreak plantings and are also used by wildlife for protection and as a source of food. Both soils in capability unit VIe-3 dryland; Ortello soil, in Sandy range site and Sandy windbreak group; Coly soil, Limy Upland range site and Silty to Clayey windbreak group.

Platte Series

The Platte series consists of somewhat poorly drained soils that formed in loamy alluvium and are shallow over sand and gravel. These soils are on bottom land in the Platte River Valley. They are nearly level to very gently sloping. Mixed sand and gravel is at a depth of about 16 inches.

In a representative profile, the surface layer is gray fine sandy loam about 7 inches thick. Beneath this is the underlying material. The upper part is light brownish-gray very fine sandy loam and the middle part is light-gray loamy sand. At a depth of 16 inches is light-gray, mixed sand and gravel. The water table is at a depth of 30 inches.

Platte soils have moderately rapid permeability in the upper part but very rapid permeability in the underlying sand and gravel. They have a low available water capacity. The organic-matter content is moderate, and fertility is low. The soil is moderately alkaline throughout the profile. The water table fluctuates from 2 to 5 feet below the surface in most areas. It is highest late in fall or early in spring and is lowest late in summer.

These are excellent soils for range and hay. Only a few areas are under cultivation.

Representative profile of Platte fine sandy loam in a native hay meadow 500 feet east and 200 feet north of the southwest corner of sec. 34, T. 16 N., R. 2 W.:

A—0 to 7 inches, gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; moderate, medium to fine, crumb structure; soft, very friable; calcareous; moderately alkaline; clear, smooth boundary.

C1—7 to 12 inches, light brownish-gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; few, fine, distinct, yellowish-brown mottles; weak, medium, subangular blocky structure; soft, very friable; calcareous; moderately alkaline; clear, smooth boundary.

C2—12 to 16 inches, light-gray (10YR 7/2) loamy sand, light brownish gray (10YR 6/2) moist; common, medium, distinct, yellowish-brown mottles; single grain; loose; moderately alkaline; clear, smooth boundary.

IIC3—16 to 60 inches, light-gray (10YR 7/2) mixed sand and gravel; few, coarse, distinct, yellowish-brown mottles in upper 8 inches; single grain; moderately alkaline; water table at a depth of 30 inches.

The A horizon ranges from 6 to 12 inches in thickness and from silt loam to loamy sand in texture. Carbonates are within a depth of 10 inches. The C1 horizon is 3 to 10 inches thick and ranges from silt loam to sandy loam. Depth to the IIC3 horizon ranges from 10 to 20 inches.

Platte soils are near Wann, Alda, Leshara, and Lamo soils. They are shallower over sand and gravel than any of these soils and have coarser textured underlying material than Leshara or Lamo soils.

Platte fine sandy loam (0 to 1 percent slopes) (Pf).—This shallow, somewhat poorly drained soil is on bottom land. It is commonly in the remnants of old channels of the Platte River. Areas are irregular in shape and range from 10 to 60 acres in size.

This soil has the profile described as representative for the series. Included in mapping were a few areas of soils that are less than 10 inches deep over sand and gravel, areas of Alda soils, and areas of soils that have a silty clay loam surface layer, but are otherwise similar to Platte soils.

Wetness, particularly early in spring, is the principal hazard. It commonly delays planting and cultivation. This soil warms up late in spring. Soluble salts are common on the surface layer in fall, but are usually washed away by melting snow and spring rain. Runoff is slow.

Late in summer and early in fall, when the water table is lowest, this soil is droughty in areas under dryland management. In other seasons, after planting, the water table is high enough to benefit certain crops.

Most areas are used for grazing or are mowed for hay. Grasses grow well because this soil is subirrigated. The few cultivated areas are generally irrigated. Some are farmed along with surrounding deeper soils. This soil is suited to trees and to use by wildlife. Capability unit IVw-4 dryland and IVw-4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Platte-Alda complex (0 to 2 percent slopes) (PL).—These soils are on bottom land in the Platte River Valley. They occur in mixed patterns, and most areas of the individual soils are too small to be mapped separately.

About 60 percent of the acreage is Platte soils, and 35 percent is Alda soils. The remaining 5 percent is soils of minor extent. Platte soils are in the lowest parts of the landscape. Alda soils are on low flat ridges 1 to 3 feet higher than Platte soils.

Both of these soils have profiles similar to those described as representative for their respective series. Included in mapping were some small areas of soils that are less than 10 inches deep and small areas of Wann fine sandy loam and Alda fine sandy loam.

Wetness in spring, when rainfall is plentiful, and flooding after heavy rain are the main hazards. Late in summer when the water table is lowest and rainfall not so plentiful, the soils are droughty. The cultivated soils under dryland management are also droughty because the available water capacity is low.

Most areas are in native grass and are used for grazing or mowed for hay. A few areas are cultivated. Corn, small grain, alfalfa, and grain sorghum are the crops most commonly grown. These soils are suitable for windbreak plantings. Wildlife use areas of these soils for shelter and as a source of food. Capability units IVw-4 dryland and IVw-4 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Rough Broken Land, Loess

Rough broken land, loess (31 to 100 percent slopes) (RB) is on breaks to the Platte River Valley and along some of the more deeply entrenched, intermittent drainageways. It is pale-brown or light yellowish-brown loess that is mainly silt loam or loam in texture. In some places there is a weakly developed, thin, dark-colored surface layer. Catstep topography is common in most areas (fig. 11). The vegetation consists of mixed native grasses, forbs, and short trees.

Included in mapping were small areas of Coly soils and areas of Hobbs soils in the bottoms of some drainageways.

Figure 11.—**Rough broken land, loess, is well suited to native grass and is used as range. It is too steep and rough for cultivated crops.**

Rough broken land, loess, is calcareous at or near the surface. Permeability is moderate. Available water capacity is high, but runoff is very rapid and moisture seldom penetrates to a depth of 5 feet. The organic-matter content is very low, and natural fertility is low. Reaction is mildly alkaline or moderately alkaline near the surface.

Some areas are well suited to grazing if properly managed but are too steep for cultivated crops or for irrigation. Capability unit VIIe-1 dryland; Thin Loess range site; Silty to Clayey windbreak group.

Sandy Alluvial Land

Sandy alluvial land (0 to 1 percent slopes) (Sx) consists mainly of stabilized riverwash that has little or no horizon development. It is mainly in the South Channel of the Platte River, which was blocked from receiving water at its source. In a few small areas along the south bank of the Platte River, this land is stabilized. It is mainly very shallow and coarse textured and is 1 to 6 inches deep over mixed sand and gravel. Receding floodwater has deposited low sand ridges.

The water table fluctuates from the surface to a depth of 3 feet; it fluctuates with the level of water in the Platte River. Permeability is very rapid, and available water capacity is very low. The organic-matter content is very low, and natural fertility is low. Runoff is slow.

Sandy alluvial land provides suitable habitat for some kinds of wildlife, and this is its chief use. It is also grazed by cattle and deer. The vegetation is trees, commonly cedars and cottonwoods; a sparse growth of native grass; and brush. Capability unit VIIs-3 dryland; Subirrigated range site; Very Wet windbreak group.

Silty Alluvial Land

Silty alluvial land (0 to 1 percent slopes) (Sy) is deep and nearly level. It consists of frequently flooded, medium-textured sediment on bottom land along intermittent and continuously flowing streams. Areas are long and narrow. Some are short, steep banks. Deposits of new alluvium are added when streams overflow their channels. Flooding occurs several times each year, but is of short duration.

Silty alluvial land is highly stratified with light and dark colors. Permeability is moderate, and the available water capacity is high. The organic-matter content is moderately low. Natural fertility is high.

Excess moisture and damage from flooding are the principal hazards. In addition, areas of this land are not readily accessible to farm machinery.

Vegetation consists of trees, brush, and grass. The grass provides some forage for cattle, but it is commonly covered with silt or is washed away by floodwater after a heavy rain. A few small areas are cultivated, but the hazard of flooding is so great that growing crops is unprofitable. Nearly all areas are used for grazing. Silty alluvial land provides excellent habitat for wildlife. Capability unit VIw-1; Silty Overflow range site; Moderately Wet windbreak group.

Slickspots

Slickspots are deep and nearly level and are on stream terraces in the Platte River Valley. They are moderately to strongly affected by salts and alkali. Runoff is slow. The texture is silt loam or silty clay loam. The salts have destroyed much of the structure. Thus, Slickspots puddle when wet. Puddling prevents the downward movement of moisture, and water remains on the surface until it evaporates. Slickspots are mapped only with Cozad soils.

In a typical area, the upper 6 inches is grayish-brown silt loam. Beneath this is a transitional layer of slightly lighter colored silt loam or light silty clay loam about 3 inches thick. The underlying material is light brownish-gray, friable silt loam.

Permeability is slow in the upper 6 inches. Available water capacity is high, but it is not fully utilized because of the breakdown of structure. Reaction is strongly alkaline to very strongly alkaline as far down as the underlying material, which is neutral or mildly alkaline. Natural fertility and the organic-matter content are low.

Many areas are cultivated along with the fertile Cozad soils. Some areas are leveled and irrigated. Uncultivated areas are in native grass and are used for range.

Thurman Series

The Thurman series consists of deep, coarse-textured, somewhat excessively drained soils. These soils formed in alluvium reworked by wind on stream terraces in the Platte River Valley. The topography is hummocky. Slopes range from nearly level to gently rolling.

In a representative profile, the surface layer is loamy sand 16 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. Beneath this is a transitional layer of light brownish-gray loamy fine sand about 6 inches thick. The underlying material is very pale brown loose loamy sand (fig. 12).

Thurman soils are neutral throughout the profile. Permeability is rapid, and the available water capacity is low. The organic-matter content is moderately low, and natural fertility is low.

Most areas are in native grass and are used for grazing. Some areas are cultivated, and a few of these are irrigated.

Representative profile of Thurman loamy sand, 0 to 5 percent slopes, in a cultivated field 100 feet west and 50 feet south of the northeast corner of sec. 34, T. 16 N., R. 1 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak, medium and coarse, granular structure; soft, very friable; neutral; clear, smooth boundary.

A12—6 to 16 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak, coarse, blocky structure; soft, very friable; neutral; clear, smooth boundary.

AC—16 to 22 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure; soft, very friable; neutral; clear, smooth boundary.

C—22 to 60 inches, very pale brown (10YR 7/3) loamy sand, brown (10YR 5/3) moist; single grain; loose; neutral.

The A horizon ranges from 6 to 19 inches in thickness. An AC, or transitional horizon, is present in some profiles. The C horizon is loamy sand or sand. In places it contains dark-colored layers of a buried soil.

Thurman soils are near Blendon, Hord, Meadin, and O'Neill soils. They are deeper than Meadin and O'Neill soils and do not have the sand and gravel underlying material that is typical of those soils. Thurman soils are coarser textured than Blendon or Hord soils.

Thurman loamy sand, 0 to 5 percent slopes (TcB).—This hummocky, coarse-textured soil is on stream terraces where the alluvium was reworked by wind. It has the profile described as representative for the series.

Included in mapping were small areas of Meadin soils and areas of soils that have dark-colored layers of a buried soil in the underlying material. In places the lower part of the underlying material is stratified with moderately coarse textured and medium-textured material.

Soil blowing is a serious hazard unless this soil is adequately protected. The soil is droughty because the available water capacity is low. Runoff is slow because much of the water from rainfall is absorbed about as rapidly as it falls. Increasing the level of fertility is essential, particularly in irrigated areas. The soil can be cultivated soon after a rain, and it is easy to work.

Many areas of this soil are in native grass and are used for range. Cultivated areas are in wheat, grain sorghum, corn, and alfalfa. They are particularly well suited to sprinkler irrigation. This soil is suited to windbreak plantings. Wildlife use the areas for shelter and as a source of food. Capability units IVe-5 dryland and IVe-5 irrigated; Sandy range site; Sandy windbreak group.

Thurman loamy sand, 5 to 11 percent slopes (TcC).—This hummocky, gently rolling, coarse-textured soil has a profile similar to the one described as representative for the series, but the surface layer is only about 10 inches thick.

Included in mapping were small areas of Meadin soils, areas of soils that contain the surface layer of a buried

***Figure 12.*—Profile of Thurman loamy sand, a deep, coarse-textured soil that formed in wind-deposited material.**

soil, and areas where the lower part of the underlying material is stratified with moderately coarse textured and medium-textured material.

This soil is droughty. Soil blowing is a severe hazard in areas where the soil is disturbed. Runoff is slow because most of the water from rainfall is absorbed by this porous soil.

Most of the acreage is in native grass and is used for range. This soil is suited to windbreak plantings. Wildlife use the areas as a source of food. Capability unit VIe–5 dryland; Sands range site; Very Sandy windbreak group.

Wann Series

This series consists of deep, moderately coarse textured, somewhat poorly drained, nearly level soils. These soils formed in calcareous alluvium on bottom land in the Platte River Valley. The water table fluctuates between depths of 2 and 6 feet.

In a representative profile, the surface layer is calcareous fine sandy loam about 16 inches thick. It is dark gray in the upper part and gray in the lower part. The underlying material is mottled light brownish-gray sandy loam in the upper part and gray sandy loam in the lower part.

Wann soils have moderately rapid permeability and moderate available water capacity. The organic-matter content is moderate, and natural fertility is medium. The surface layer is mildly alkaline. Soluble salts are on the surface in some areas early in spring and late in fall, but they are washed away by rain and melting snow.

Most of the acreage is cultivated and is suited to irrigation. Some of the acreage is in native grass and is used for grazing or is mowed for hay.

Representative profile of Wann fine sandy loam in a cultivated field 800 feet south and 100 feet east of the northwest corner of sec. 28., T. 16 N., R. 1 W.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak, medium, granular structure; soft, very friable; calcareous; mildly alkaline; abrupt, smooth boundary.

A12—6 to 16 inches, gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak, very coarse, subangular blocky structure parting to moderate, medium, granular; soft, very friable; calcareous; moderately alkaline; clear, wavy boundary.

C1—16 to 50 inches, light brownish-gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; common, medium, distinct, yellowish-brown mottles; soft, very friable; calcareous; mildly alkaline; clear, wavy boundary.

C2g—50 to 60 inches, gray (10YR 6/1) sandy loam, dark gray (10YR 4/1) moist; single grain; loose, very friable;

calcareous; small, soft, white lime deposits above the water table; moderately alkaline; water table at a depth of 54 inches.

The A horizon ranges from 12 to 19 inches in thickness and the C1 horizon from 20 to 36 inches. The soil is normally calcareous at the surface; lime is within a depth of 10 inches. The depth to mixed sand and gravel ranges from 40 to about 72 inches. In many places the C horizon is stratified with lenses of medium-textured and coarse-textured material.

Wann soils are near Cass, Leshara, and Inavale soils. They are similar to Cass soils, but have a water table that is closer to the surface. They are coarser textured than Leshara soils. Compared with Inavale soils, they are not so coarse textured and are more poorly drained.

Wann fine sandy loam (0 to 1 percent slopes) (Wb).—This somewhat poorly drained soil is deep and moderately coarse textured. It is on bottom lands. Areas are irregular in shape and range from about 10 to 60 acres in size.

Included in mapping were small areas of Leshara and Alda soils, and some areas there is a dark-colored layer of a buried soil in the underlying material, and some areas where sand and gravel is at a depth of 40 to 60 inches.

Wetness can be a limitation at planting time. Runoff is slow. This soil warms up more slowly in spring than well-drained soils. It is very friable, is easy to work, and absorbs moisture readily. It is calcareous. Phosphate is not readily available. Maintaining a high level of fertility is essential, particularly in irrigated areas.

Most of the acreage is cultivated. Corn, grain sorghum, wheat, alfalfa, and spring-sown small grain are grown. Uncultivated areas are in native grass and are used for grazing or mowed for hay. This soil is suited to windbreak plantings. It is used by wildlife. Capability units IIw–6 dryland and IIw–6 irrigated; Subirrigated range site; Moderately Wet windbreak group.

Wet Alluvial Land

Wet alluvial land consists of poorly drained, nearly level soil material in old channels on bottom land along the Platte River. The soil material is shallow to deep over sand and gravel. It is mainly medium textured, but layers of moderately fine, moderately coarse, and coarse textured material are common. The water table fluctuates within a depth of 2 feet. The soil material is calcareous at the surface; no lime occurs below the water table.

Permeability is moderate as far down as the underlying sand and gravel and very rapid through that material. Available water capacity ranges from low to high. This is not a significant factor because the solum is saturated most of the time. Reaction is neutral or moderately alkaline in the upper part of the soil material.

Wet alluvial land is used almost entirely for range or hayland. Attempts to cultivate it have not been successful because it is too wet. This land is well suited to native grass and trees and to use as wildlife habitat and recreational areas.

Wet alluvial land-Alda complex (0 to 1 percent slopes) (Wx).—This mapping unit is 40 to 80 percent Wet alluvial land and 20 to 60 percent Alda fine sandy loam. Wet alluvial land is in old, abandoned channels of the Platte River, and Alda fine sandy loam is on the low, flat ridges between the channels.

The Alda soil is described under the heading "Alda Series." Included in mapping were a few small areas of Platte, Wann, and Leshara soils.

Wetness is the main hazard. Flooding of the low channels is common after a heavy rain. Bogs form in low areas that are grazed when the water table is near the surface.

All areas are well suited to grazing. Some are mowed for hay. None are suited to cultivated crops. All can be used for growing trees. Wildlife use the areas for protection and as a source of food. Capability unit Vw–1 dryland; Wet alluvial land, Wet Land range site and Very Wet windbreak group; Alda soil, Subirrigated range site and Moderately Wet windbreak group.

Use and Management of the Soils

This section provides information on the use and capabilities of the soils of Polk County for irrigated and dryland crops; information on the range sites of the different soils in the county, their correct management, and their potential for producing native grass; and information on the native woodland, the suitability of the soils for windbreaks, and the trees suitable for planting. This section also evaluates the suitability of the soils as wildlife habitat and reports data from engineering tests and interpretations of soil properties that affect highway construction and other engineering structures.

Management of the Soils for Crops [2]

Erosion of gently sloping to moderately sloping soils by water, the flooding of soils adjacent to streams and drainageways, and the loss of fertility by topsoil removal and soil blowing are the principal soil limitations in Polk County. Most soils of the county are suited to crops, pasture, or range if they are well managed and the limitations can be overcome. Some soils, because of their properties and the erosion hazard, are poorly suited to cultivated crops and are better suited to range or to wildlife and recreational uses.

The cultivated acreage in Polk County occupies about 82 percent of the total land area. According to the Nebraska Agricultural Statistics Report (*5*), about 40 percent of the total cropland acreage, or 86,700 acres, was irrigated in 1968.

Corn is the principal irrigated crop. Winter wheat and grain sorghum are the principal dryland crops. Small acreages of soybeans, alfalfa, rye, oats, and grasses for pasture and hay are also grown. Each year part of the cropland is summer fallowed, or used for temporary pasture, or planted to grasses or legumes.

Water erosion can be controlled by terraces, contour farming, land leveling, contour bench leveling, and grassed waterways. These practices are suited to soils, such as Hastings silt loam, 3 to 7 percent slopes. They are most effective if used in combination with good management practices. By keeping crop residue on the surface or by growing a protective cover of plants, crusting of the soil after intense rain can be prevented. Tall stubble left on the soil during winter will catch drifting snow and replenish moisture in soils under dryland management.

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

Productive soils that have little or no erosion hazard can be used for row crops, and the steeper, more erodible soils for hay and pasture. This helps reduce soil loss.

Soil blowing on soils, such as Darr, Inavale, Ortello, and Thurman soils, can be reduced by protecting them from wind action. Stubble-mulch tillage for small grain, mulch planting for row crops, and narrow fields of alternate row crops and small grain help reduce wind velocity on the surface and thus reduce the hazard of soil blowing.

Managing tillage during seedbed preparation to eliminate all but the essential disturbance of the soil and planting only those crops that leave maximum crop residue on the surface are beneficial in improving the physical condition of the soil. These practices also reduce soil losses and lessen compaction of the soil.

All soils producing crops and pasture in Polk County can be tested to determine the need of commercial fertilizer for sustained high crop production. Fertilizer applications should be based on the results of soil tests, along with some consideration of the soil moisture supply in dryfarmed areas. A dry subsoil in an area of limited rainfall needs a slightly lower application of fertilizer than that normally used. Nitrogen fertilizer increases vegetative growth on all soils in the county. Phosphorus and zinc are commonly needed on the eroded, upland Cozad and Hastings soils. Soils in irrigated areas require larger amounts of fertilizer because of the possibility of greater plant production in these areas.

Proper grading is needed for efficient use of the water in gravity irrigation. Grading provides uniform water distribution and better control of irrigation runoff. Sprinklers can be used on most arable soils, and furrows and borders can be used on the deep, level to gently sloping soils. An irrigation system that controls and manages runoff from sloping fields is desirable in preventing loss of runoff and providing for reuse of the water.

In Polk County, all soils and soil material, except Gravel pits, are suited to grass for pasture or range. All except Gravel pits and Sandy alluvial land are suited to windbreak plantings. They are also suited to use by wildlife or as recreational sites. A more complete discussion of these less intensive uses is given in this section under the related heading.

Capability grouping

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

In the capability system, all kinds of soil are grouped at three levels, the capability class, the subclass, and the unit. These levels are described 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 or 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 Polk 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, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils (*10*). Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or VIs-4. 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 Polk County are described and suggestions for the use and management of the soils are given. The names of the soil series represented are mentioned in the description of each unit, but this does not mean that all the soils in a given series are in the unit. The capability unit designation for each soil in the county can be found in the "Guide to Mapping Units."

CAPABILITY UNITS I-1 DRYLAND AND I-1 IRRIGATED

These units consist of deep, nearly level soils of the Cozad, Hall, Hastings, Holder, Hord, and Leshara series. These soils are on uplands, stream terraces, and bottom land. They have a medium-textured surface layer, a medium-textured to moderately fine textured subsoil, and medium-textured underlying material. All but Leshara soils are well drained. The Leshara soil has a water table at a depth of 6 to 10 feet.

Permeability is moderate to moderately slow. Available water capacity is high, and surface runoff is slow. These soils absorb moisture well and release it readily to plants. They are easy to work. The organic-matter content is moderately low to moderate. Natural fertility is medium to high. These are some of the best soils in Polk County for farming.

The principal management need is maintaining the organic-matter content and a high level of fertility. Soil blowing is a hazard unless the surface is adequately protected.

Dryland management.—Corn, sorghum, small grain, soybeans, and alfalfa are the main crops (fig. 13). Crop residue on the surface and adequate fertilization are needed to maintain these soils for sustained crop production. Crop diseases and insects can be controlled if row crops are alternated with small grain or hay and pasture crops.

Irrigation management.—Corn, sorghum, alfalfa, soybeans, and tame grasses are suitable irrigated crops. Slight irregularities in the land surface can make it difficult to obtain uniform distribution of irrigation water unless the land is leveled. Most kinds of irrigation are suitable. Crop residue left on the surface in winter helps control soil blowing. Irrigation 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. Irrigation runoff at the ends of the fields can be trapped in a pit and recycled into the irrigation system.

CAPABILITY UNITS IIe-1 DRYLAND AND IIe-1 IRRIGATED

These units consist of deep, well-drained, very gently sloping soils of the Cozad, Hastings, Hobbs, and Holder series. These soils are on uplands, stream terraces, and colluvial-alluvial slopes. They have a medium-textured surface layer, a medium-textured to moderately fine textured subsoil, and medium-textured underlying material.

Permeability is moderate to moderately slow. Available water capacity is high, and surface runoff is medium. These soils absorb water well and release it readily to plant roots. Their organic-matter content is moderately low to moderate. Natural fertility is medium to high.

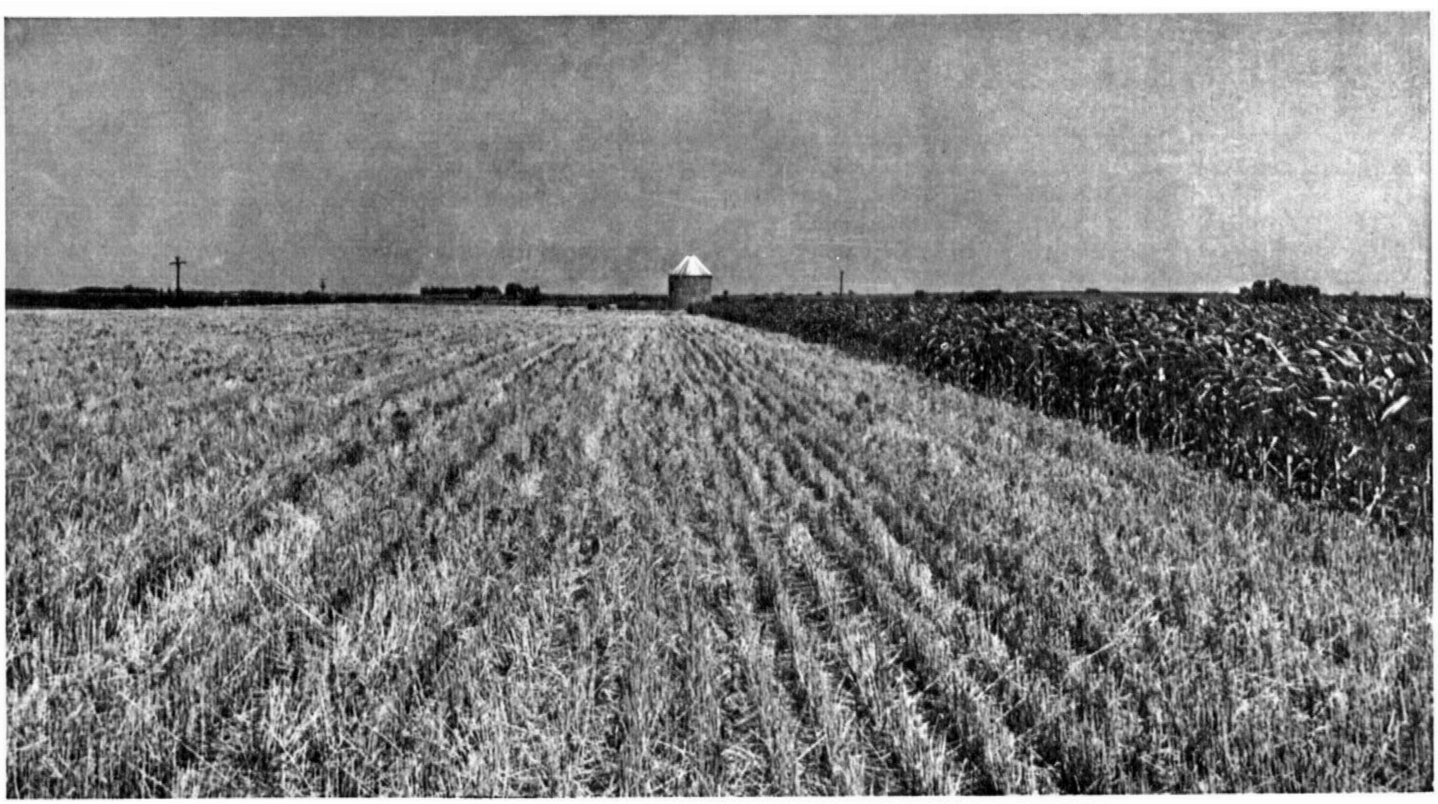

***Figure 13.*—Hastings silt loam, 0 to 1 percent slopes, is well suited to both dryland and irrigated management.**

Control of runoff is needed to keep a supply of moisture in the soil. Maintaining good tilth, high fertility, and a large supply of organic matter is needed under all types of management.

Dryland management.—These soils are suited to corn, sorghum, small grain, soybeans, alfalfa, and hay crops. Terracing, contour farming, and the use of grassed waterways help control runoff. A cropping system that keeps the soil covered with vegetation most of the time helps reduce the loss of soil moisture.

Irrigation management.—Corn, sorghum, soybeans, and alfalfa are the major irrigated crops. Leveling is needed for efficient gravity irrigation. Leveling provides an even distribution of irrigation water and prevents excessive leaching of fertilizers. A legume crop should be grown occasionally. Crop residue left on the surface increases the water-intake rate and reduces the hazard of soil blowing. Controlling irrigation runoff and conserving it at the ends of the fields are essential practices in management.

CAPABILITY UNITS IIe-3 DRYLAND AND IIe-3 IRRIGATED

These units consist of deep and moderately deep, moderately coarse textured soils of the Blendon, Cass, Darr, and O'Neill series. These nearly level to gently sloping soils are on bottom land and stream terraces. The Blendon, Cass, and O'Neill soils are well drained, and the Darr soils are somewhat excessively drained.

Permeability is moderately rapid, and available water capacity ranges from low to high. Surface runoff is slow. These soils absorb water well and release it readily to plants.

Soils in these units are subject to both soil blowing and water erosion. Control of erosion is the main concern, but conserving moisture and maintaining organic matter and fertility are also essential.

Dryland management.—These soils are suited to corn, sorghum, small grain, soybeans, and alfalfa. Because of the wide range in available water capacity, these sandy soils can be somewhat droughty during dry periods.

Water erosion and soil blowing can be reduced and the moisture conserved by use of stripcropping, stubble-mulch tillage, and a cropping system that keeps the soil covered with grasses or crop residue most of the time. Row crops can be alternated with small grain and legume crops. A cropping system that includes mulch tillage reduces soil blowing. Terracing and contour farming used with grassed waterways are needed where row crops are grown.

Irrigation management.—Under irrigation these soils are well suited to corn, sorghum, small grain, soybeans, and alfalfa. The supply of organic matter can be increased by growing small grain and legumes in the rotation and by using mulch tillage that leaves crop residue on the soil.

Furrow and border irrigation methods are suitable. The high water-intake rate makes it necessary to limit the length of field irrigation runs. Reducing and recycling irrigation runoff at the ends of the fields conserve water. On very gentle slopes, where land leveling is more costly than in nearly level areas, sprinkler irrigation is suitable.

The optimum use of commercial fertilizer and barnyard manure is needed.

CAPABILITY UNITS IIw-2 DRYLAND AND IIs-2 IRRIGATED

The one soil in these units, Butler silt loam, is a deep, somewhat poorly drained, nearly level soil that developed in shallow depressions on loess uplands. This soil has a medium-textured surface layer and a fine-textured subsoil.

Permeability is slow. Available water capacity is high, and surface runoff is very slow. This soil absorbs water slowly and releases it slowly to plants.

Excessive wetness for short periods in spring is the main hazard in cultivated areas. The wetness delays tillage and retards crop growth, but a complete crop loss is infrequent. Keeping fertility at a high level is essential.

Dryland management.—The soil is suited to wheat, corn, grain sorghum, soybeans, and alfalfa. Of these, wheat and grain sorghum are the most suitable. A suitable cropping system includes 3 or 4 years of row crops, followed by small grain or legumes.

Irrigation management.—Corn, grain sorghum, soybeans, and alfalfa are suitable irrigated crops. Growing alfalfa in the cropping sequence aids in the movement of water through the soil. The slow intake rate makes longer irrigation sets necessary. Water management that controls and reduces excess irrigation runoff is also needed.

CAPABILITY UNITS IIw-3 DRYLAND AND I-2 IRRIGATED

Only one soil, Hobbs silt loam, occasionally flooded, is in these units. This deep, medium-textured, nearly level soil is on bottom land. It is a moderately well drained soil that is occasionally flooded for short periods following heavy rain. Permeability is moderate. Available water capacity is high, and water intake is moderate. This soil absorbs water well and releases it readily to plant roots.

The major management concern is occasional flooding.

Dryland management.—This soil is suited to corn, sorghum, small grain, soybeans, and alfalfa. Occasional flooding in spring can limit production of small grain and alfalfa, but during dry periods it is beneficial to crops because it adds to the needed supply of moisture. Flooding is of short duration, and crop damage is seldom severe.

In most areas, diversions and drainage ditches are needed to reduce flooding. They intercept runoff and keep it from spreading over a wide area. They have to be kept clean if they are to serve the purpose of intercepting the floodwaters.

Flooding occasionally delays planting and cultivation in spring.

Irrigation management.—Corn and sorghum are the most suitable irrigated crops. If flooding is controlled, alfalfa, small grain, and soybeans can be grown.

Land leveling and an irrigation system that provides for the diversion or interception of floodwater are needed. Reducing and controlling irrigation runoff at the ends of fields are important. Mulch tillage provides useful protection for this soil where irrigated crops are grown. Furrow and border irrigation systems are suitable. Sprinklers can be used also.

CAPABILITY UNITS IIw-4 DRYLAND AND IIw-4 IRRIGATED

These units consist of deep and moderately deep, nearly level soils of the Alda, Lamo, and Leshara series. These somewhat poorly drained soils are on bottom land.

They have a medium-textured to moderately fine textured surface layer and substratum and a moderately high water table.

Permeability ranges from moderately slow to moderately rapid. Available water capacity is low to high, and surface runoff is slow. These soils absorb water well and release it readily to plants.

Wetness is the main management concern. It commonly delays tillage. These soils warm up slowly in spring.

Dryland management.—These soils are suited to corn, sorghum, soybeans, alfalfa, and spring-sown small grain. Small grain and alfalfa are the least suitable because of the high water table in spring. Many areas of this unit are in native grass and are used for hay or pasture (fig. 14).

The wetness and high water table can be controlled by using diversions, drainage ditches, or tile drains. Control of the water table is difficult, but if controlled, it allows more timely seedbed preparation and planting.

Irrigation management.—Under irrigation management, these soils are suited to corn, sorghum, soybeans, and alfalfa. Leveling is needed where furrow and border irrigation systems are used. Leveling also provides better surface drainage. Excessive application of irrigation water leaches soil fertility to depths below plant roots. Drainage ditches, tile drains, and diversions help lower the water table.

CAPABILITY UNITS IIw-6 DRYLAND AND IIw-6 IRRIGATED

These units consist of nearly level, deep and moderately deep, moderately coarse textured soils of the Alda and Wann series. These somewhat poorly drained soils are on bottom land.

Permeability is moderately rapid. Available water capacity is low to moderate, and surface runoff is slow.

***Figure 14.*—Area of Lamo silty clay loam, sandy substratum, in the Platte River Valley. Native grass is harvested for hay.**

These soils absorb water well and release it readily to plants.

The major management concerns are controlling wetness in spring, controlling soil blowing during dry periods, and maintaining soil fertility.

Dryland management.—Corn, sorghum, and alfalfa are well suited to these soils. Spring-sown small grain and soybeans can be grown but are not so well suited because the soil is wet at the time of seedbed preparation. If suitable outlets are available, the water table can be lowered somewhat by using drainage ditches or tile drains. Lowering the water table helps the soil to warm up earlier in spring and allows earlier tillage and planting. A cropping system that includes close-growing crops and alfalfa is suited to these soils. Alfalfa eliminates the need for tillage in spring and also serves as protection from soil blowing where the soil is dry. Returning crop residue to the soil surface increases the supply of organic matter and also protects the soil against blowing.

Irrigation management.—Irrigated crops suited to these soils are corn, sorghum, soybeans, and alfalfa. Increased amounts of fertilizer are needed to offset the high production from these crops. Leveling is needed if furrows and borders are used for irrigation. Deep cuts for leveling should be avoided. Sprinklers are suitable in areas where land leveling is impractical. Small but frequent applications of water are needed because the soils are moderately coarse textured and have only a low to moderate available water capacity.

CAPABILITY UNITS IIIe–1 DRYLAND AND IIIe–1 IRRIGATED

This unit consists of deep, well-drained, gently sloping soils of the Cozad, Hastings, and Hobbs series. These soils are on stream terraces, foot slopes, and uplands. They have a medium-textured surface layer and a medium to moderately fine textured subsoil.

Permeability of these soils is moderate to moderately slow. Available water capacity is high, and surface runoff is medium. These soils absorb water well and release it readily to plant roots.

Water erosion is the main hazard. Conserving moisture and maintaining good tilth, high fertility, and a large supply of organic matter are essential practices in management. Soil blowing can occur unless the surface is adequately protected.

Dryland management.—These soils are well suited to corn, sorghum, small grain, soybeans, and alfalfa. In hot, dry summers, crops can be damaged from the lack of moisture.

Terraces, grassed waterways, contour farming, and the use of crop residue as mulch reduce runoff and the hazard of water erosion and soil blowing. Water erosion can be reduced and moisture conserved by using a cropping system that keeps the soil covered most of the time, for example, limiting the years of consecutive row crops and planting close-growing crops of small grain, hay, or similar crops. The use of mulch tillage during seedbed preparation can supplement the mechanical erosion control practices.

Irrigation management.—Alfalfa and grasses are well-suited irrigated crops. Corn, soybeans, and sorghum are suited if the hazard of erosion can be reduced. Terraces, contour irrigation, waterways, and the maximum use of crop residue on the soil are suggested erosion control measures. Soil fertility can be maintained and improved by using manure and commercial fertilizer.

Sprinkler irrigation is well suited to these soils. The slope and the combined effects of natural rainfall and the additional water from irrigation make it difficult to control water erosion. The rate at which irrigation water is applied should not exceed the intake rate of the soil.

Furrow and border irrigation can be used on these soils, if slopes are leveled so that water erosion and runoff are kept to a minimum. Contour bench leveling is suited to the gently sloping soils in these units.

CAPABILITY UNITS IIIe–3 DRYLAND AND IIIe–3 IRRIGATED

Only one soil, Blendon fine sandy loam, 1 to 3 percent slopes, is in these units. This is a deep, well-drained, moderately coarse textured soil on stream terraces.

Permeability is moderately rapid. Available water capactity is high, and surface runoff is slow. This soil absorbs water well and releases it readily to plant roots.

This soil is subject to blowing. Also, the hazard of water erosion is slight. Conserving moisture and maintaining the organic-matter content and high fertility are essential.

Dryland management.—This soil is suited to corn, sorghum, small grain, soybeans, and alfalfa.

The hazards of soil blowing and water erosion can be reduced and the moisture conserved if row crops are alternated with small grain, mulch tillage is used, and the soil covered with residue most of the time (fig. 15).

Irrigation management.—Suitable irrigated crops are corn, small grain, sorghum, alfalfa, soybeans, and grasses. Furrows and borders can be used for irrigating this nearly level to very gently sloping soil. Sprinklers are suitable in areas where land leveling is not practical. Control of irrigation water is easiest on level fields. Deep cuts in leveling should be avoided because they expose the coarse-textured material. Frequent irrigation is needed, but excessive applications are to be avoided because fertility is leached to depths below the plant roots. Irrigation runoff has to be controlled.

CAPABILITY UNITS IIIe–5 DRYLAND AND IIIe–5 IRRIGATED

Only one soil, Inavale loamy fine sand, 0 to 3 percent slopes, is in these units. This deep, excessively drained, coarse-textured soil is on bottom land. It is nearly level to very gently sloping.

Permeability is rapid, and available water capacity is low. Surface runoff is slow because most of the water is absorbed rapidly. This soil absorbs water well and releases it readily to plant roots. Natural fertility is low.

Soil blowing is a severe hazard unless the soil is protected. The major management concern is erosion control, but conserving moisture and increasing the supply of organic matter and improving fertility are also essential.

Dryland management.—Corn, sorghum, small grain, and alfalfa are well suited. Small grain and the first cutting of alfalfa generally are dependable crops because they grow and mature in spring when rainfall is highest.

The hazard of soil blowing can be reduced, the moisture conserved, and fertility maintained if the cropping system used keeps the soil covered with crop residue most

Figure 15.—Field of dryfarmed soybeans after a 4-inch rain. Stubble mulch protects this Blendon soil against erosion.

of the time. Limiting the number of years of consecutive row crops and planting some close-growing crops protect the soil and conserve moisture. Planting a close-growing crop and a row crop in alternate narrow strips and using narrow tree windbreak plantings help control soil blowing.

Irrigation management.—Corn and alfalfa are well-suited irrigated crops. Small grain, grasses, and legumes are also suited.

Furrow, border, and sprinkler irrigation can be used on this soil. Land leveling is required if furrows and borders are to be used. Deep cuts should be avoided during leveling because there is danger of exposing the coarser underlying material. Maintaining a soil cover of growing crops or crop residue is essential to the control of soil blowing. Frequent, light irrigations are needed because excessive irrigation leaches fertilizer below the depth of plant roots.

CAPABILITY UNITS IIIe-8 DRYLAND AND IIIe-11 IRRIGATED

These units consist of deep, well-drained, severely eroded, gently sloping soils of the Hastings and Cozad series. These soils are on uplands. Both the surface layer and subsoil are medium textured to moderately fine textured.

Permeability is moderate or moderately slow. Available water capacity is high, and surface runoff is medium. The soils absorb water well and release it readily to plant roots.

The water erosion hazard is the major management concern. Conserving moisture, maintaining good tilth, improving fertility, and increasing the supply of organic matter are essential. Rapid surface runoff results in the loss of rainwater and is likely to cause a moisture shortage in summer.

Dryland management.—Corn, sorghum, small grain, and alfalfa are the most suitable crops.

Runoff and the hazard of water erosion can be controlled by using terraces, grassed waterways, and contour farming. A system that keeps the soil covered with crops or residue most of the time is an effective supplement to mechanical water control practices. The years of consecutive row crops can be limited and a close-growing crop of small grain, hay, or similar crop can be grown in the rotation. Also, mulch tillage can be used during seedbed preparation. Small gullies can be shaped and seeded to grass. Grassed field borders help to control runoff and can be used as turnrows, roadways, and wildlife habitat.

Irrigation management.—Tame grass and alfalfa are well-suited irrigated crops. If erosion control is practiced, corn and sorghum are also suited. The hazard of erosion can be controlled by terraces, contour irrigation, grassed waterways, and the maximum use of crop residue as a mulch. Soil fertility can be maintained or improved by using manure and commercial fertilizers.

Sprinklers can be used for irrigating. Controlling soil erosion is difficult on these gently sloping soils under the combined effects of natural rainfall and irrigation water. The rate at which water is applied should not exceed the intake rate of the soil. Contour bench leveling is suited to the more gently sloping soils. In such areas furrows and borders can be used for irrigating.

CAPABILITY UNITS IIIs-1 DRYLAND AND IIs-1 IRRIGATED

Only one mapping unit, Cozad-Slickspots complex, terrace, is in these units. These soils are deep and nearly level. The Cozad soil is well drained. The saline-alkali Slickspots make up about 30 percent of the mapping unit.

Permeability ranges from slow to moderate. Available water supply is high, and surface runoff is slow. The Cozad soil absorbs water readily and releases it readily to plant roots. Slickspots absorb water slowly and release it slowly to plants.

The major limitation is the alkalinity of the Slickspots. Tilth is poor, and crop stands are generally sparse and stunted. The alkali is toxic to some plants.

Dryland management.—Sorghum, small grain, alfalfa, and alkali-tolerant grasses are well-suited crops. Small grain and the first cutting of alfalfa generally are more dependable because they grow and mature in spring when rain is more frequent. Corn is moderately well suited. Soybeans are not well suited.

High level management is needed in cultivated areas because the soils are droughty. Generally, best results are obtained by growing salt-tolerant crops and by using a cropping system that keeps the soil covered with crop residue most of the time. This reduces evaporation of moisture and helps correct the alkali and salinity limitations. Barnyard manure is particularly effective on the alkali soils.

Irrigation management.—Sorghum, small grain, alfalfa, and alkali-tolerant grasses are some of the best suited irrigated crops. Corn is moderately well suited. Furrows, borders, and sprinklers can be used for irrigation. For the furrow and border systems, land leveling is needed to provide efficient irrigation and drainage. Leveling also covers the Slickspots areas with more fertile soil material.

CAPABILITY UNITS IIIw-2 DRYLAND AND IIs-21 IRRIGATED

These units consist of only one soil, Fillmore silt loam. This deep, poorly drained, nearly level soil formed in depressions on the loess uplands. It has a medium-textured surface layer and a fine-textured subsoil. It is subject to occasional flooding.

Permeability is slow. Available water capacity is high, and surface runoff is ponded. This soil absorbs water slowly and releases it slowly to plants.

Wetness from flooding is the main hazard. Drainage to remove the excess water is difficult unless a suitable outlet is available. Wetness limits the choice of crops and commonly delays tillage in spring.

Dryland management.—This soil is suited to corn, sorghum, small grain, and tame grass. It is better suited to sorghum and small grain than to corn. Alfalfa is seldom grown on this soil because it is susceptible to drowning. Terraces and diversions can be constructed on the surrounding higher soils to divert runoff from the lower lying areas. If outlets are available, open ditches can be used to remove much of the excess water.

Irrigation management.—Suitable irrigated crops are corn, alfalfa, sorghum, and tame grass. A cropping system that includes a legume or a legume-grass mixture can help in maintaining the fertility, the tilth, and the capacity of this soil to absorb water. Returning crop residue to the soil increases the organic-matter content.

Furrows and borders are suitable for irrigation. Only a small amount of land leveling is ordinarily needed. The leveling provides for surface drainage. Where outlets are available, drainage ditches or tile drains can be installed to remove the excess surface water. Fertility can be maintained if commercial fertilizer and barnyard manure are applied.

CAPABILITY UNITS IVe-1 DRYLAND AND IVe-1 IRRIGATED

These units consist of only one soil, Cozad silt loam, 7 to 11 percent slopes. This soil is deep, well drained, and moderately sloping. It occurs on uplands. It has a medium-textured surface layer and subsoil.

Permeability is moderate. Available water capacity is high, but surface runoff is rapid. This soil absorbs water well and releases it readily to plant roots. The major hazards are water erosion and the loss of water by runoff. This soil is marginal for cultivated crops.

Dryland management.—Alfalfa, grasses, and wheat are well-suited dryfarmed crops. Grain sorghum and corn are less well suited. A cropping system that severely limits the use of row crops helps reduce erosion. Terraces, contour farming, grassed waterways, and the use of crop residue and mulch tillage are all needed to supplement cropping practices.

This soil is also suitable for pasture, range, and woodland, and as wildlife habitat and recreational areas. After an area is converted to grass, the hazard of water erosion can be reduced if a part of the yearly growth is left on the soil after the grazing season.

Irrigated management.—Alfalfa and grasses are well-suited irrigated crops. Corn and sorghum are suited if erosion control is practiced, for example, terraces, contour farming and waterways, and maximum use of crop residue on the soil. Furrows and borders are suitable for irrigation if contour bench leveling has been done. Sprinklers are also suitable. The moderate slopes, rapid runoff, and accumulated water from both rainfall and irrigation make control of soil erosion difficult. The rate at which irrigation water is applied should not exceed the intake rate of the soil.

CAPABILITY UNITS IVe–3 DRYLAND AND IVe–3 IRRIGATED

These units consist of deep, well-drained, moderately sloping soils of the Ortello series. These soils are on uplands. They have a moderately coarse textured surface layer and subsoil. In some areas they are eroded.

Permeability is moderately rapid. Available water capacity is high, and surface runoff is rapid. These soils absorb water well and release it readily to plants. The erosion hazard is slight to severe.

The major hazards on these soils are water erosion and soil blowing. Conserving moisture and maintaining the supply of organic matter and a high level of fertility are important concerns in management.

Dryland management.—Small grain, tame grass, alfalfa, and other close-growing crops are well suited to these soils. Corn and sorghum are not so well suited. Narrow strips of row crops are alternated with alfalfa or another close-growing crop and trees in narrow windbreak plantings reduce the hazard of soil blowing. A cropping system that keeps the soil covered with vegetation or crop residue most of the time is also needed.

Irrigated management.—Irrigated corn, sorghum, small grain, alfalfa, and tame grass can be grown, but plant populations should be kept at a higher level than that required under dryland farming. Sprinkler irrigation is well suited. Frequent, light irrigation is needed to avoid excessive leaching of plant nutrients. Slopes greater than 9.5 percent are not suited to irrigation because of the erosion hazard.

CAPABILITY UNITS IVe–5 DRYLAND AND IVe–5 IRRIGATED

Only one soil, Thurman loamy sand, 0 to 5 percent slopes, is in these units. This is a deep, somewhat excessively drained, nearly level to gently sloping soil on a stream terrace. The surface layer and underlying material are coarse textured.

Permeability is rapid. Available water capacity is low, and surface runoff is slow. The soil absorbs water easily and releases it readily to plant roots. Natural fertility is low.

Soil blowing and droughtiness are the main hazards. Conserving moisture, increasing the organic-matter content, and improving fertility are essential practices in management.

Dryland management.—Dryfarmed crops well suited to this soil are corn, sorghum, small grain, grass, and alfalfa. Small grain and the first cutting of alfalfa are generally the most dependable because they grow in spring when rainfall is highest. The hazard of soil blowing can be reduced if narrow strips of row crops are alternated with close-growing crops. Windbreak plantings in one or two rows are effective. The cropping rotation selected can be one that keeps the soil covered with vegetation and crop residue most of the time. Planting a row crop in spring and interplanting with rye or hairy vetch early in fall is an example of a cropping system that provides a cover of crop residue at all times. Soil fertility can be improved if commercial fertilizer and barnyard manure are applied.

Irrigated management.—Corn, sorghum, small grain, tame grass, and alfalfa are suitable irrigated crops. Mulch planting and keeping a crop or crop residue on the soil surface at all times help control soil blowing. Sprinkler irrigation is well suited. Furrows can be used on the less sloping soil. Frequent, light irrigation is needed. Avoiding overirrigation reduces the possibility of leaching soil nutrients below the root zone of plants.

CAPABILITY UNIT IVe–51 DRYLAND

This unit consists of shallow and deep, nearly level to gently sloping soils of the Inavale and Platte series. These soils are on bottom land. They are moderately coarse to coarse textured in the surface layer and underlying material. Inavale soils are excessively drained, and Platte soils are somewhat poorly drained. Platte soils are underlain by sand and gravel.

Permeability is moderately rapid to rapid. Available water capacity is low, and surface runoff is slow. Natural fertility and the organic-matter content are low. These soils absorb water well and release it readily to plant roots.

Soil blowing is the major hazard. Other concerns in management are conserving moisture, maintaining the supply of organic matter, and improving fertility. In addition, Platte soils are wet and Inavale soils are droughty.

Dryland management.—Crops suited to these soils are corn, sorghum, small grain, tame grass, and alfalfa. The hazard of soil blowing can be reduced by using a cropping system that keeps the soil covered with vegetation or crop residue most of the time, and by planting narrow strips consisting of a row crop and a close-growing crop. Soil fertility can be improved and maintained if commercial fertilizer is applied. Barnyard manure is of value in increasing vegetative growth, and it improves the organic-matter content and fertility of the soil.

CAPABILITY UNITS IVe–8 DRYLAND AND IVe–11 IRRIGATED

This unit consists of moderately sloping and severely eroded soils of the Hastings and Cozad series. These soils are deep and well drained and have a medium-textured or moderately fine textured surface layer and subsoil. They are on uplands, along streams and intermittent drainageways (fig. 16).

Permeability is moderate to moderately slow. Available water capacity is high, and surface runoff is rapid. These soils absorb water well and release it readily to plants. They are subject to severe water erosion. Reducing runoff, improving fertility, and increasing the supply of organic matter are essential practices in management.

Dryland management.—Small grain, grass, alfalfa, and similar close-growing crops are suited to these soils. Row crops are not suited because of the erosion hazard. One of the better practices is to seed the areas to native grasses and use them for range. Terraces, grassed waterways, contour farming, and the use of crop residue as mulch help control runoff and erosion. Mulching also helps improve the supply of organic matter in the soil.

Shaping and seeding of gullied areas, using a good grass cover, and seeding waterways may be needed. Grass field borders help control runoff at the ends of fields, and these areas can be used as turnrows, roadways, and wildlife habitats. Keeping the grass healthy and vigorous helps control erosion and reduces runoff.

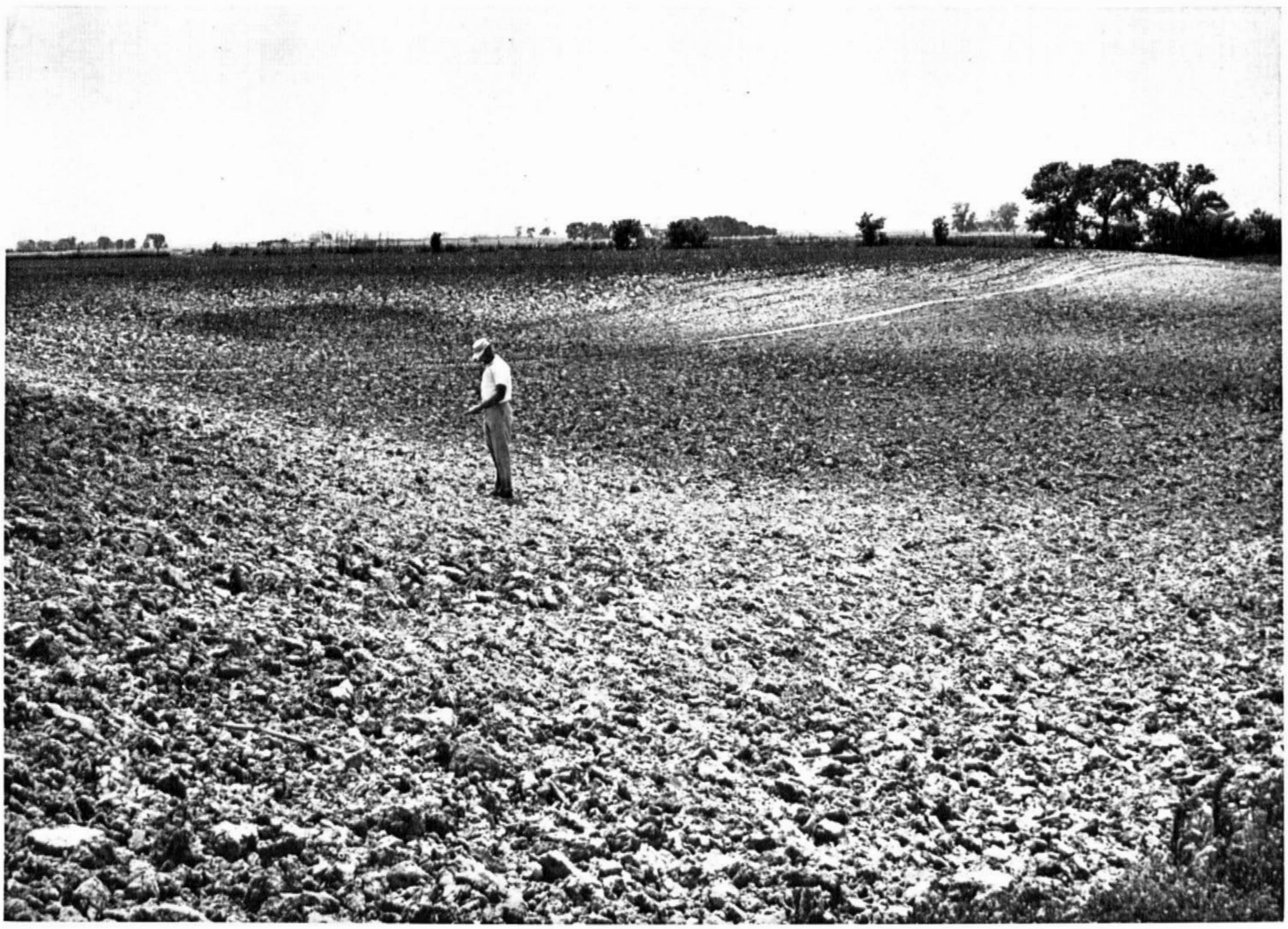

***Figure 16.*—Severely eroded Hastings soil is suited to small grain, alfalfa, tame grass, and other close-growing crops.**

Irrigated management.—Suitable irrigated crops are tame grass, alfalfa, and small grain. Corn and sorghum should be used sparingly in the cropping sequence. Terraces, grassed waterways, and contour farming help to control erosion.

Sprinkler irrigation is the most suitable. The rate at which water is applied should not exceed the intake rate of these soils. Furrow and border irrigation are suitable in areas that are farmed on the contour.

CAPABILITY UNITS IVw-4 DRYLAND AND IVw-4 IRRIGATED

These units consist of shallow to moderately deep, somewhat poorly drained, nearly level to very gently sloping soils of the Alda and Platte series. These soils are on bottom land. They have a moderately coarse textured surface layer and substratum and are underlain by sand and gravel.

Permeability is moderately rapid. Available water capacity is low, and surface runoff is slow. These soils absorb water well and release it readily to plant roots. Fertility ranges from low to medium.

The major management concerns are wetness and soil blowing. Maintaining fertility, particularly in irrigated areas, is essential.

Dryland management.—The value of cultivated crops on these soils is limited. Corn, sorghum, small grain, and tame grass can be grown in some areas. Alfalfa is sensitive to flooding and is not so well suited unless satisfactory surface drainage can be established. The soils are well suited to range or hay (fig. 17).

Soil blowing can be reduced, moisture conserved, organic-matter content increased, and fertility improved through the use of a cropping system that keeps the soil covered with crops, grass, or crop residue. In cultivated areas, good results are obtained by limiting the number of row crops and including a maximum number of close-growing crops in the cropping sequence to protect the soil and conserve moisture.

Irrigated management.—If irrigated, these soils are suited to corn, sorghum, small grain, and grasses. The hazard of soil blowing can be reduced by leaving crop residue on the surface as a mulch. Surface drainage can be provided by installing drainage ditches or by land leveling. Effective lowering of the water table is difficult, but in places, tile drains are helpful.

Figure 17.—**Hay meadow on Platte fine sandy loam.**

Sprinklers can be used for irrigating. Frequent applications are needed because the available water capacity is low. Light applications are needed to avoid excessive leaching of plant nutrients.

CAPABILITY UNIT Vw-1 DRYLAND

Only one mapping unit, Wet alluvial land-Alda complex, is in this unit. It consists of shallow to deep, poorly drained and somewhat poorly drained, nearly level soils on bottom land. The surface layer and subsoil are moderately fine textured to coarse textured.

Permeability is moderate to rapid. Available water capacity is low to high, and surface runoff is slow. These soils absorb water well and release it readily to plant roots. The water table is high in Wet alluvial land and moderately high in Alda soils.

The major hazard is wetness. Because of this the soils are not suitable for cultivation, and generally, it is not practical to drain them. Flooding occurs in spring when rainfall is heaviest.

Dryland management.—Nearly all the acreage is used for permanent hay or range. Boggy conditions develop in range areas that are grazed while the water table is at the surface. Proper stocking and deferred grazing help maintain healthy grasses and prevent the development of boggy areas. There is a possibility that the carrying capacity on this unit can be increased by introducing reed canarygrass or a similar grass. These areas are also suitable for the development of wildlife food and cover.

CAPABILITY UNIT VIe-3 DRYLAND

This unit has only one mapping unit, Ortello-Coly complex, 11 to 31 percent slopes. These soils are deep, well drained, and moderately steep to steep. They are on uplands. The surface layer and subsoil are medium textured to moderately coarse textured.

Permeability is moderate or moderately rapid. Available water capacity is high, and surface runoff is rapid. These soils absorb water well and release it readily to plant roots.

The major management concern is reducing runoff and the hazard of erosion. The soil is subject to severe water erosion and to soil blowing if it is overgrazed or if the surface is left unprotected.

Dryland management.—These soils are not well suited to cultivated crops because they are too steep and erodible. They are well suited to range or woodland, or to development for use as wildlife habitat and recreational areas. Nearly all areas are in grass and are used for grazing. Proper stocking, deferred grazing, and the control of weeds and brush help maintain and increase the stands of grass. More uniform grazing can be obtained through proper distribution of salt and water for livestock.

CAPABILITY UNIT VIe–5 DRYLAND

This unit has only one soil, Thurman loamy sand, 5 to 11 percent slopes. This deep, coarse-textured, gently sloping to moderately sloping soil is on stream terraces. It is somewhat excessively drained.

Permeability is rapid. Available water capacity is low, and surface runoff is slow because the water is absorbed before it can run off. This soil absorbs water well and releases it readily to plant roots. It is subject to severe soil blowing if the surface is left unprotected.

The major management concerns are controlling soil blowing and maintaining a healthy, vigorous stand of grass.

Dryland management.—This soil is poorly suited to cultivated crops because it is sandy, droughty, and highly erodible. Some areas are cultivated, but production is generally low. This soil is well suited to grass. Proper range management is needed, for example, proper stocking, deferred grazing, rotation grazing, and control of weeds and brush. Proper distribution of salt and water results in more uniform grazing by livestock. This soil is also suited to trees for windbreak plantings and to the development of wildlife habitat and recreational areas.

CAPABILITY UNIT VIe–9 DRYLAND

The only soil in this unit is Coly silt loam, 11 to 31 percent slopes (fig. 18). This is a deep, well-drained, moderately steep to steep soil on loess uplands. The texture of the surface layer and underlying material is silt loam. Lime is at or near the surface.

Permeability is moderate. Available water capacity is high, and surface runoff is rapid. The soil absorbs water well and releases it readily to plant roots. It is low in organic-matter content and natural fertility.

The erosion hazard is severe on the steep slopes. Conserving the surface water supply, controlling erosion, and managing the range areas are the main concerns.

Dryland management.—This soil is poorly suited to cultivated crops, but is well suited to range. Under proper management, areas now cultivated can be seeded to native grass and used as range. Proper stocking, deferred grazing, and control of weeds and brush help in establishing and maintaining a good grass cover. Uniform grazing of livestock can be obtained through proper distribution of salt and water.

Stockwater dams, erosion control structures, and flood detention reservoirs can be built in the bottom of some drainageways. This unit is also suited to trees, to development as wildlife habitat, and to recreational areas.

CAPABILITY UNIT VIs–4 DRYLAND

This unit has only one soil, Meadin loamy sand, 0 to 5 percent slopes. This is a shallow, nearly level to gently sloping soil on stream terraces. Texture of the surface layer and underlying material is loamy sand. Sand and gravel are at a depth of about 17 inches.

Permeability is rapid. Available water capacity is very low, and surface runoff is slow. This soil absorbs water well and releases it readily to plant roots. Natural fertility is low.

The main hazard is droughtiness. Soil blowing is a concern where vegetation is damaged or destroyed.

Dryland management.—This soil is suited to native grasses. Nearly all of the acreage is used for grazing. Areas now cultivated can be seeded to a mixture of native grasses. Grazing can be controlled on both native and seeded areas to insure that at least part of each year's growth is left on the soil as a mulch.

CAPABILITY UNIT VIw–1 DRYLAND

Only Silty alluvial land is in this unit. It is nearly level, medium-textured soil material along streams and larger intermittent drainageways on bottom land. It is commonly flooded after a heavy rain. It is dissected by deep, meandering stream channels and short, steep banks. The scouring action of floodwaters and the deposition of silt in other areas are concerns of management. Vegetation consists of trees, shrubs, and grass.

The major management concern is the control of flooding. Most areas are inaccessible to machinery because of the entrenched stream channels.

Dryland management.—Silty alluvial land is not suited to cultivated crops because it is broken into small units by deeply entrenched stream channels and is frequently flooded after a rain. It is well suited to grass, trees, and the development of wildlife habitat and recreational areas.

Most of the acreage is permanent range. Proper stocking, deferred grazing, and the control of weeds and brush increase forage yields. Many areas support little grazing because they are either covered with trees or dissected by entrenched stream channels.

In some areas large floodwater detention structures can be used to reduce flooding.

CAPABILITY UNIT VIIe–1 DRYLAND

This unit consists of very steep Rough broken land, loess. The material is medium textured and shows very little soil formation. Catsteps are a common feature of the landscape. The vegetation consists mainly of grass and a few shrubs and stunted trees.

Permeability is moderate. Available water capacity is high, and runoff is very rapid. The soil material absorbs water well and releases it readily to plant roots.

The major hazard is erosion. Conserving water by reducing runoff is also a concern of management.

Dryland management.—Rough broken land, loess, is not suited to cultivated crops because it is too steep and erodible. It is suited to grass and trees and to the development of wildlife habitat and recreational areas.

***Figure 18.*—The soil that has short slopes is Coly silt loam, 11 to 31 percent slopes.**

Most of the acreage is grazed by cattle and wildlife. A good cover of grass through proper stocking and deferred grazing is needed to reduce water erosion and conserve moisture on the very steep slopes. Stockwater dams and erosion control structures can be built in the bottoms of drainageways.

CAPABILITY UNIT VIIs-3 DRYLAND

Only Sandy alluvial land is in this unit. It is in the South Channel of the Platte River, which was blocked from receiving water from the main stream. It is nearly level but has some low sandy ridges. It consists of a thin, coarse-textured surface layer over mixed sand and gravel. Sometimes the water table is at the surface. It fluctuates within a depth of 3 feet.

Permeability is rapid to very rapid. Available water capability is low to very low, and runoff is slow. Natural fertility is low. Water is absorbed easily and released readily to plants.

The major limitations are the very low available water capacity and the resulting droughtiness and low fertility.

Dryland management.—Sandy alluvial land is not suited to cultivated crops because it is shallow and droughty and has a high water table. It is well suited to grass and native trees and to the development of wildlife habitat and recreational areas. It is not well suited to windbreak plantings. Most areas are grazed.

CAPABILITY UNIT VIIIs-1 DRYLAND

Only Gravel pits is in this unit. It consists of piles of sand and the adjacent deep excavations that are filled with water.

Dryland management.—The unit Gravel pits is not suited to cultivated crops or planted trees. It can be used as wildlife habitat and recreational areas. The piles of sand can be leveled, covered with topsoil, and seeded to grass and used as a site for recreational cabins. The water in the pits can be used for fishing and other types of recreation.

Predicted yields

Predicted yields of principal crops grown on the arable soils in Polk County are shown in table 2. Two levels of management are listed for both irrigated and dryland soils. In columns A are yields to be expected under average management and in columns B, yields under high-level management. Soils that are not used for at least one principal crop are omitted from the table.

Average management (A level) is practiced by the greatest number of farmers. Only moderate amounts of fertilizers and lime are used. The supply of organic matter, control of erosion, maintenance of tilth, and the supply of soil nitrogen most likely fall short of optimum requirements. Weed, disease, and insect control and the use of certified seed may or may not be used.

Correcting the deficiencies typical of average management and improving such items as timeliness, crop varieties, and total plant populations are likely to result in significant increases in yield.

High-level management (B level) is within the reach of most farmers. It consists of the application of presently known farming practices and treatments needed for any specific combination of soils, crops, livestock, and climate. This level of management includes the use of drainage, irrigation, and erosion control measures; proper tillage; control of weeds, insects, and diseases; the use of top

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

[Yields in columns A are those to be expected under average management; those in columns B, under high-level management. Dashes indicate that the soil is considered unsuitable for the crop or the crop is not commonly grown on the soil]

Soil	Grain sorghum				Wheat		Corn				Alfalfa			
	Dryland		Irrigated		Dryland		Dryland		Irrigated		Dryland		Irrigated	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Alda fine sandy loam	50	63	77	91	27	33	40	55	85	100	1.7	2.2	2.3	3.2
Alda loam	52	67	80	95	23	35	45	65	90	115	1.9	2.3	4.0	5.0
Blendon fine sandy loam, 0 to 1 percent slopes	60	78	89	104	27	38	48	68	100	120	3.0	4.0	4.5	5.4
Blendon fine sandy loam, 1 to 3 percent slopes	55	72	84	99	22	36	45	62	85	100	2.9	3.9	4.0	5.0
Butler silt loam	50	63	104	115	26	35	45	60	90	115	2.4	3.5	3.9	5.1
Cass fine sandy loam	57	75	86	103	24	37	45	65	100	120	2.9	3.9	4.2	5.4
Cozad silt loam, 3 to 7 percent slopes	57	77	86	101	25	36	50	70	90	115	2.8	4.1	4.5	5.4
Cozad silt loam, 7 to 11 percent slopes	48	67	-----	-----	21	31	40	60	-----	-----	2.4	3.7	-----	-----
Cozad silt loam, terrace, 0 to 1 percent slopes	62	81	94	111	30	42	55	75	100	130	3.2	4.7	4.9	5.9
Cozad silt loam, terrace, 1 to 3 percent slopes	59	79	89	104	26	37	55	72	95	120	2.9	4.4	4.6	5.5
Cozad silt loam, terrace, 3 to 7 percent slopes	56	72	85	99	22	31	50	67	90	110	2.6	4.1	4.0	5.2
Cozad soils, 3 to 7 percent slopes, severely eroded	51	68	-----	-----	20	30	45	60	-----	-----	2.6	3.7	3.8	4.5
Cozad soils, 7 to 11 percent slopes, severely eroded	44	61	-----	-----	17	25	45	55	-----	-----	2.4	3.4	-----	-----
Cozad-Slickspots complex, terrace	52	67	85	101	21	29	50	65	80	95	2.3	3.7	-----	-----
Darr fine sandy loam	50	60	80	94	21	31	40	55	75	95	1.8	2.1	2.3	3.2
Fillmore silt loam	47	59	102	110	25	33	40	55	85	105	2.0	3.0	3.4	4.6
Hall silt loam, 0 to 1 percent slopes	66	86	99	119	33	46	62	82	120	150	3.2	4.7	4.9	6.2
Hastings silt loam, 0 to 1 percent slopes	65	84	98	118	32	45	60	80	120	145	3.2	4.8	4.8	6.3
Hastings silt loam, 1 to 3 percent slopes	60	80	91	105	27	38	58	77	105	130	3.0	4.4	4.5	5.9
Hastings silt loam, 3 to 7 percent slopes	56	73	87	100	23	32	52	70	90	110	2.7	4.1	4.2	5.4
Hastings soils, 3 to 7 percent slopes, severely eroded	50	67	-----	-----	20	30	40	55	-----	-----	2.5	3.6	3.7	4.4
Hastings soils, 7 to 11 percent slopes, severely eroded	43	60	-----	-----	17	25	35	50	-----	-----	2.3	3.3	3.2	3.9
Hobbs silt loam, occasionally flooded	64	85	94	111	25	35	50	75	100	135	3.0	3.5	4.1	6.2
Hobbs silt loam, 0 to 3 percent slopes	65	84	94	106	30	41	62	80	100	130	3.2	4.2	4.6	5.8
Hobbs silt loam, 3 to 7 percent slopes	60	78	87	100	27	34	57	73	90	110	2.9	4.0	4.5	5.6
Holder silt loam, 0 to 1 percent slopes	67	87	98	118	33	47	60	80	120	150	3.4	5.0	4.9	6.4
Holder silt loam, 1 to 3 percent slopes	62	82	91	106	27	40	58	77	105	135	3.1	4.5	4.8	5.9
Hord silt loam, 0 to 1 percent slopes	72	89	105	126	35	48	70	85	125	155	4.2	5.5	6.2	7.5
Inavale loamy fine sand, 0 to 3 percent slopes	53	66	-----	-----	21	30	37	50	-----	-----	2.5	3.4	-----	-----
Inavale loamy sand, 3 to 7 percent slopes	43	55	-----	-----	17	25	32	43	-----	-----	2.2	3.1	-----	-----
Inavale-Platte complex	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Lamo silty clay loam, sandy substratum	54	75	87	102	26	31	40	65	80	100	3.1	4.2	4.4	5.5
Leshara silt loam	55	80	88	105	31	41	50	70	100	120	3.4	4.5	4.5	5.6
Leshara silt loam, drained	71	90	104	126	35	48	70	90	120	150	4.2	5.5	6.2	7.5
Ortello complex, 7 to 11 percent slopes	42	59	-----	-----	18	28	35	50	-----	-----	2.3	3.3	-----	-----
Ortello complex, 7 to 11 percent slopes, eroded	40	54	-----	-----	16	25	30	42	-----	-----	2.1	3.1	-----	-----
Thurman loamy sand, 0 to 5 percent slopes	40	53	-----	-----	17	25	30	45	-----	-----	2.1	3.1	-----	-----
Wann fine sandy loam	59	75	-----	-----	27	39	48	70	85	110	3.1	4.2	4.4	5.5

quality seeds sown in optimum stands; timely application of limestone, phosphate, and nitrogen in the amounts indicated from soil tests and past experience; efficient use of crop residue; and the use of a cropping system that maintains the organic-matter content.

The yield predictions in table 2 are based on information furnished by supervisors of the Upper Big Blue and Central Platte Natural Resource District, on information from representatives of the Soil Conservation Service, and from observations and comparisons made by others who are familiar with the soils and farming in the county. These estimates are averages per seeded acre, under tried and proven methods, over the past 5 years. They take into account the years of good moisture supply as well as the poor, but do not include losses from hail or other unpredictable causes.

Management of the Soils for Range [3]

Range amounts to about 15 percent of the total acreage in Polk County. It occurs as widely scattered areas throughout the county. There are several areas of range along the Platte River. The largest areas are in the Coly-Cozad and Thurman-Meadin associations. The second largest farm enterprise in Polk County is the raising of livestock, mainly cow and calf herds. Calves are held over or sold for stocker-feeder programs.

Range sites and condition classes

Different kinds of range sites produce different kinds and amounts of native grasses. For proper range management, an operator needs to know the different kinds of range sites in his holding and the native plants that grow on each site. Management can then favor growth of the best forage plants.

Range sites are distinctive kinds of range that differ in their ability to produce a significantly different kind and proportion of climax, or original, vegetation. A significant difference is one great enough to require some variation in management, such as a different stocking rate. Climax vegetation is the combination of plants that originally grew on a given site. The most productive combination of range plants on a site is generally the climax vegetation.

Range condition is classified according to the percent of vegetation on the site that is original, or climax, vegetation. This classification is used in comparing the kind and amount of present vegetation with that which the site can produce. Changes in range condition result mainly from changes in intensity of grazing and from drought (fig. 19).

Climax vegetation can be altered by intensive grazing. Livestock graze selectively. They constantly seek plants that are the most palatable and nutritious. Plants react to grazing in one of three ways; they become decreasers, increasers, or invaders. Decreaser and increaser plants are climax plants. Generally, *decreasers* are the most heavily grazed and, consequently, are the first to be injured by overgrazing. *Increasers* are less palatable to livestock and withstand grazing better; they increase under grazing and replace the decreasers. *Invaders* are weeds that become established after the climax vegetation has been reduced by grazing.

Range condition is expressed in four condition classes to show the present condition of the vegetation on a range site compared with the vegetation that grew on it originally. The condition is *excellent* if 76 to 100 percent of the vegetation is climax; *good* if 51 to 75 percent is climax; *fair* if 26 to 50 percent is climax; and *poor* if 25 percent or less is climax vegetation.

Management and improvement practices

Management that maintains or improves range condition is needed on all rangeland, regardless of other practices used: proper grazing use, deferred grazing, and planned grazing systems. The proper distribution of livestock in a pasture can be improved by correctly locating fences, livestock water developments, and salting facilities.

Range seeding improves range condition. Native grass, either wild harvest or improved strains, can be seeded or reseeded on land suitable for use as range. Soils, such as Ortello-Coly complex, 11 to 31 percent slopes; Meadin loamy sand, 0 to 5 percent slopes; and Coly silt loam, 11 to 31 percent slopes, that are still used as cropland are suited to range seeding. The most important grasses in the seed mixture should include big bluestem, sand bluestem, little bluestem, indiangrass, switchgrass, and side-oats grama. No special care other than management of grazing is needed to maintain forage composition.

Descriptions of range sites

The 13 range sites in Polk County are described in the paragraphs that follow. The descriptions include (1) the topography in each site, (2) a brief description of the mapping units in each site, (3) the dominant vegetation on the site when in excellent condition, (4) the dominant vegetation in poor range condition, and (5) the total annual yield in pounds per acre of air-dry weight for years when rainfall is average and the site is in excellent condition.

The range site designation for each soil in the county can be determined by referring to the "Guide to Mapping Units."

WET LAND RANGE SITE

Only Wet alluvial land is in this site. It is mapped with Alda soils and is on bottom land. It is nearly level, ranges widely in texture, and is shallow to deep. The water table fluctuates between the surface and a depth of 2 feet most of the year. In the early part of the growing season, water generally stands on the surface.

The climax plant cover is a mixture of decreaser grasses, such as prairie cordgrass and reedgrasses. These grasses make up at least 65 percent of the total plant cover. The rest is other perennial grasses and forbs. Sedge is the principal increaser.

When the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, redtop, willows, and sparse amounts of prairie cordgrass and sedge.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 6,000 to 7,000 pounds per acre.

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

Figure 19.—**Fenceline contrast showing undergrazed range on left and overgrazed on right. The soil is Thurman loamy sand, 0 to 5 percent slopes. Sandy range site.**

SUBIRRIGATED RANGE SITE

This site consists of shallow to deep, nearly level soils of the Alda, Lamo, Leshara, Platte (fig. 20), and Wann series and Sandy alluvial land. All are on bottom land. These soils range widely in texture and have a calcareous surface layer.

The kind of vegetation that grows on this site is influenced by a water table that fluctuates between depths of 2 and 6 feet. The water table is rarely at the surface but remains within the root zone during the growing season.

The climax plant cover is a mixture of decreaser grasses, such as big bluestem, indiangrass, switchgrass, prairie cordgrass, and Canada wildrye. These grasses make up at least 75 percent of the plant cover. The rest is other perennial grasses and forbs. Little bluestem, western wheatgrass, and sedge are the principal increasers.

When the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, foxtail barley, redtop, blue verbena, and sparse amounts of western wheatgress and sedge.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 5,000 to 6,000 pounds per acre.

SILTY OVERFLOW RANGE SITE

This site consists of a nearly level Hobbs silt loam and Silty alluvial land. Both are on bottom land that is flooded periodically. The texture of the surface layer and underlying material ranges from silt loam to silty clay

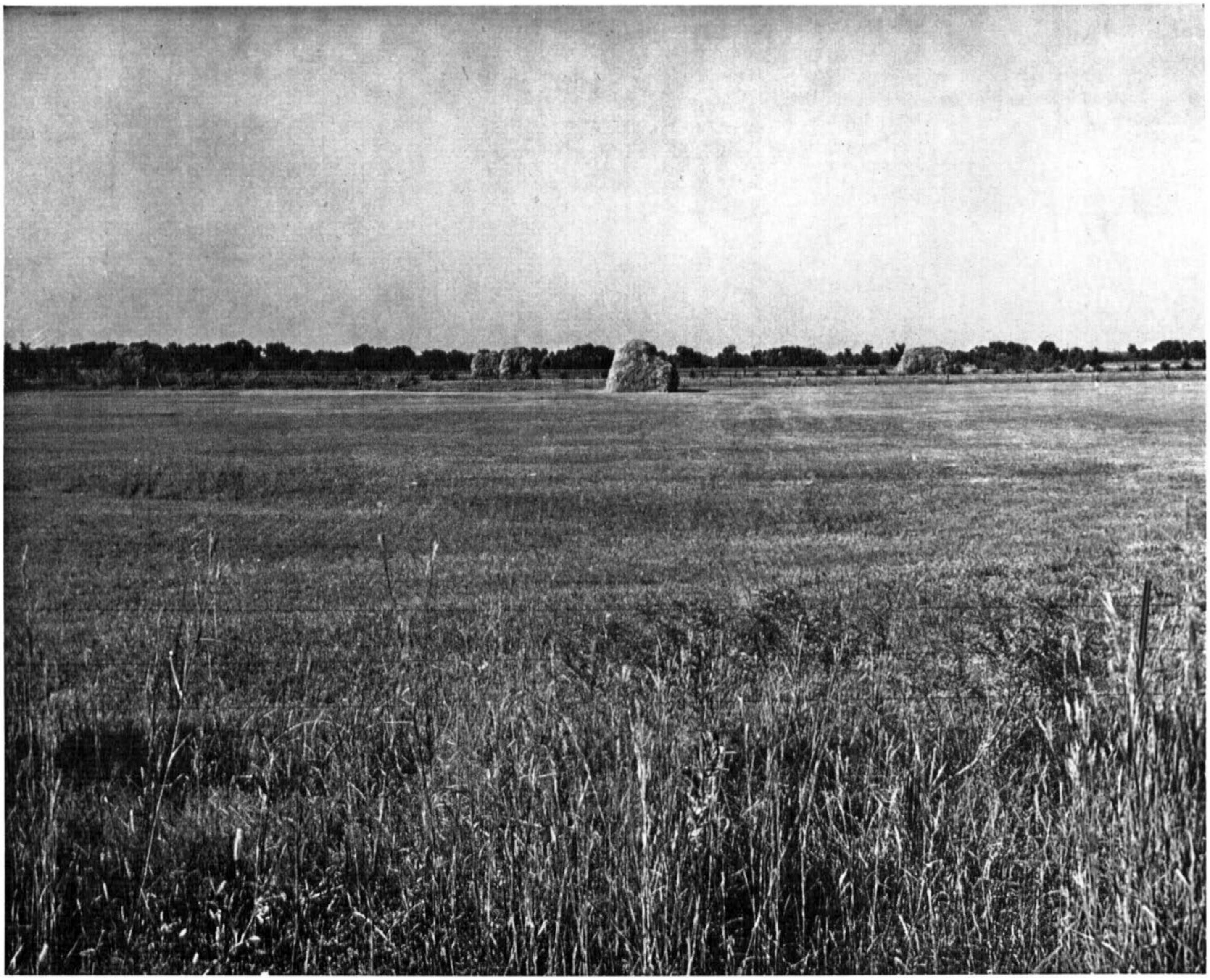

Figure 20.—**Hay harvested late in summer on Subirrigated range site. This is a mixture of native grasses on a Platte soil.**

loam. The available water capacity is high, and permeability is moderate. The kind of vegetation that grows is influenced by the overflow of streams or by the additional water that runs in from higher elevations.

The climax plant cover is a mixture of decreaser grasses, such as big bluestem, indiangrass, switchgrass, and Canada wildrye. These grasses make up at least 70 percent of the total plant cover. The rest is other perennial grasses and forbs. Western wheatgrass, little bluestem, side-oats grama, and sedge are the principal increasers.

When the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, Baldwin ironweed, western wheatgrass, and blue grama.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 4,500 to 5,000 pounds per acre.

CLAYEY OVERFLOW RANGE SITE

The only soil in this site is the nearly level Fillmore silt loam. The texture is silt loam in the surface layer and silty clay in the subsoil. This site is in upland depressions. It is subject to flooding and ponding. Permeability is slow.

The climax plant cover is a mixture of big bluestem, Canada wildrye, indiangrass, little bluestem, switchgrass, and other decreaser grasses. These grasses make up at least 65 percent of the total plant cover. The rest is other perennial grasses and forbs. Blue grama, side-oats grama, western wheatgrass, and sedge are the principal increasers.

When the site is in poor range condition, the typical plant community consists of western ragweed, Kentucky bluegrass, Baldwin ironweed, western wheatgrass, blue grama, and buffalograss.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 3,500 to 4,000 pounds per acre.

SILTY LOWLAND RANGE SITE

In this site are soils of the Cozad, Hall, Hobbs, Hord, and Leshara series and Slickspots. These soils are on bottom land and stream terraces. They are nearly level to gently sloping and have a silt loam surface layer and a very fine sandy loam to silty clay loam subsoil. This site is seldom flooded. The kind of vegetation that grows is influenced by the additional water that runs in from higher elevations. The available water capacity is high, and permeability is moderate or moderately slow.

The climax plant cover is a mixture of decreaser grasses, such as big bluestem, indiangrass, little bluestem, switchgrass, needle-and-thread, and Canada wildrye. These grasses make up at least 75 percent of the total plant cover. The rest is other perennial grasses and forbs. Blue grama, side-oats grama, and western wheatgrass are the principal increasers.

When the site is in poor range condition, the typical plant community consists of Kentucky bluegrass, western wheatgrass, blue grama, Baldwin ironweed, and western ragweed.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 4,500 to 5,000 pounds per acre.

SANDY LOWLAND RANGE SITE

Soils in this site are in the Cass and Darr series. These soils are nearly level. The soil texture is fine sandy loam in the surface layer and ranges from sandy loam to fine sandy loam in the underlying material. This site is on bottom land. The kind of vegetation that grows is influenced by the additional beneficial moisture obtained from a water table that is at a depth of 6 to 9 feet. The soils are flooded periodically, but not frequently.

The climax plant cover is a mixture of decreaser grasses, such as sand bluestem, indiangrass, switchgrass, little bluestem, needle-and-thread, and Canada wildrye. These grasses make up at least 75 percent of the total plant cover. The rest is other perennial grasses and forbs. Prairie sandreed, sand dropseed, western wheatgrass, and sedge are the principal increasers.

When the site is in poor range condition, the typical plant community consists of sand dropseed, blue grama, and western ragweed.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 4,000 to 4,500 pounds per acre.

SANDS RANGE SITE

Soils in this site are in the Inavale and Thurman series. These soils are nearly level to moderately sloping. They are loamy sand or loamy fine sand in the surface layer and loamy sand to fine sand in the underlying material. This site is on bottom land and stream terraces. The kind of vegetation is influenced by deep storage of moisture that is readily released to plants.

The climax plant cover is a mixture of decreaser grasses, such as indiangrass, sand bluestem, sand lovegrass, switchgrass, prairie junegrass, and Canada wildrye. These grasses make up at least 65 percent of the total plant cover. The rest is other perennial grasses and forbs. Blue grama, little bluestem, needle-and-thread, prairie sandreed, sand dropseed, and sedge are the principal increasers.

When the site is in poor range condition, the typical plant community consists of sand dropseed, blue grama, western ragweed, and annuals.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 3,000 to 3,500 pounds per acre.

SANDY RANGE SITE

Soils in this site are in the Blendon, O'Neill, Ortello, and Thurman series. These soils are well drained to somewhat excessively drained. They are moderately deep or deep and nearly level to steep. The surface layer is fine sandy loam or loamy sand, and the subsoil and underlying material range from fine sandy loam to sand and gravel. This site is on uplands and stream terraces. The kind of vegetation that grows is influenced by the moderately rapid to rapid permeability and the moderately coarse to coarse soil texture.

The climax plant cover is a mixture of decreaser grasses, such as sand bluestem, indiangrass, switchgrass, and needle-and-thread. These grasses make up at least 70 percent of the total plant cover. The rest is other perennial grasses and forbs. Little bluestem, prairie sandreed, blue grama, sand dropseed, and western wheatgrass are the principal increasers. Blue grama, sand dropseed, sand paspalum, and western wheatgrass are the last climax grasses to disappear in a deteriorating range.

When the site is in poor range condition, the typical plant community consists of blue grama, sand dropseed, sand paspalum, windmillgrass, and tumblegrass.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 3,000 to 3,500 pounds per acre.

SILTY RANGE SITE

Soils in this site are in the Cozad, Hastings, and Holder series. These soils are nearly level to moderately sloping. They have a silt loam or silty clay loam surface layer and subsoil. This site is on uplands. The kind of vegetation that grows on this site is influenced by the moderate to moderately slow permeability; the deep, well-drained soils; and a high available water capacity.

The climax plant cover is a mixture of decreaser grasses, such as big bluestem, little bluestem, indiangrass, and switchgrass. These grasses make up at least 65 percent of the total plant cover. The rest is other perennial grasses and forbs. Blue grama, buffalograss, side-oats grama, and western wheatgrass are the principal increasers.

When the site is in poor range condition, the typical plant community consists of blue grama, buffalograss, western ragweed, blue verbena, and plains pricklypear.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 3,500 to 4,000 pounds per acre.

CLAYEY RANGE SITE

The only soil in this site is Butler silt loam. It is a deep, nearly level soil on uplands. It has a claypan subsoil. The vegetation that grows on this site is influenced by the slow permeability in the subsoil.

The climax plant cover is a mixture of decreaser grasses, such as big bluestem, Canada wildrye, indiangrass, little bluestem, and witchgrass. These grasses make up at least 55 percent of the total plant cover. The rest is other perennial grasses and forbs. Blue grama, buffalograss, tall dropseed, and western wheatgrass are the principal increasers.

When the site is in poor range condition, the typical plant community consists of buffalograss, blue grama, blue verbena, western wheatgrass, and cool-season annual grasses.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 3,000 to 3,500 pounds per acre.

LIMY UPLAND RANGE SITE

Soils in this site are in the Coly series. These are well-drained, moderately sloping to steep soils on uplands. The surface layer and underlying material are silt loam. The soils are slightly to strongly calcareous at or near the surface and in the underlying material. The kind of vegetation that grows on this site is influenced by desirable soil-water relationships and the limy soil condition.

The climax plant cover is a mixture of decreaser grasses, such as little bluestem, big bluestem, switchgrass, and indiangrass. These grasses make up at least 65 percent of the total plant cover. The rest is other perennial grasses and forbs. Blue grama, buffalograss, and side-oats grama are the principal increasers.

When the site is in poor range condition, the typical plant community consists of blue grama, buffalograss, western ragweed, blue verbena, and plains pricklypear.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 2,500 to 3,000 pounds per acre.

SHALLOW TO GRAVEL RANGE SITE

Only one soil is in this site, Meadin loamy sand, 0 to 5 percent slopes. It is on stream terraces. This soil is only 10 to 20 inches deep over coarse sand and gravel and thus has a very low available water capacity. Permeability is rapid in the underlying material and very rapid in the sand and gravel. The vegetation that grows is influenced by droughtiness.

The climax plant cover is a mixture of decreaser grasses such as big bluestem, sand bluestem, little bluestem, sideoats grama, and prairie sandreed. These grasses make up at least 70 percent of the total plant cover. The rest is other perennial grasses and forbs. Blue grama, sand dropseed, western wheatgrass, and members of the sedge family are the principal increasers.

When the site is in poor range condition, the typical plant community consists of sand dropseed, blue grama, broom snakeweed, western ragweed, and plains pricklypear.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 2,000 to 2,500 pounds per acre.

THIN LOESS RANGE SITE

Rough broken land, loess, is the only mapping unit in this site. This soil material is deep, well drained, and has a silt loam texture. It is very steep, generally exceeding a 30 percent gradient. It is calcareous at or near the surface and throughout the underlying material. This site is on uplands and colluvial slopes where there are many catsteps and landslips. The kind of vegetation that grows is influenced by the steep slopes, the very rapid runoff, the small amount of soil development, and the limy soil condition.

The climax plant cover is a mixture of decreaser grasses, such as little bluestem, big bluestem, side-oats grama, switchgrass, and plains muhly. These grasses make up at least 75 percent of the total plant cover. The rest is other perennial grasses and forbs. Blue grama, sand dropseed, and western wheatgrass are the principal increasers.

When the site is in poor range condition, the typical plant community consists of blue grama, sand dropseed, broom snakeweed, and various annuals.

If rainfall is average and the site is in excellent condition, the total annual yield of air-dry herbage is 2,000 to 2,500 pounds per acre.

Management of the Soils for Windbreaks

The native woodland in Polk County is along the larger streams and, to a lesser extent, on the bluffs or breaks above the Platte River bottom land.

A narrow band of timber grows along the Big Blue River and its tributaries in the southern part of the county. This stand, which is made up of American elm, boxelder, green ash, hackberry, willows, cottonwood, and some woody shrubs, is on soils of the Hord and Hobbs series and on Silty alluvial land. A wider forested area is along the Platte River, especially in the overflow areas and on islands in the river. This stand is chiefly cottonwood and eastern redcedar. Intermingled are American elm, hackberry, green ash, mulberry, coralberry, grapevines, roughleaf dogwood, and other woody shrubs. Sandy alluvial land (fig. 21) and soils of the Platte and Wann series support this stand. Russian-olive, an introduced small tree, has spread widely in the overflow areas.

Bluffs along the Platte River, mainly Coly soils, support scattered stands of eastern redcedar. Mulberry, boxelder, Russian-olive, smooth sumac, coralberry, and American plum and other shrubs are also present.

Scattered redcedar, American plum, and mulberry are visible throughout the county along roadsides, in fence rows, and in some hilly or gullied areas.

Native trees and shrubs of Polk County add to the beauty of the landscape. They provide important cover and food to wildlife. Small amounts of poles and fuelwood and some cedar posts are used locally. Development of a market for the considerable volume of cottonwood growing in the Platte Valley could lead to a profitable logging enterprise.

Kinds of windbreaks

Not all farms in Polk County have windbreaks (fig. 22). Some farms have inadequate windbreaks, many of which are made up wholly of broadleaf trees. These trees

[4] Prepared by GEORGE W. ALLEY and JAMES W. CARR, JR., foresters, Soil Conservation Service.

Figure 21.—**Native stand of cottonwood and eastern redcedar on Sandy alluvial land in the South Channel of the Platte River.**

lose their leaves in winter and offer the least protection when the need is greatest.

A good farmstead windbreak can substantially reduce home heating costs. If properly located, it controls snow drifting. Windbreak protection of feedlots can significantly reduce the amount of feed consumed per animal. Incidental benefits, such as wildlife habitat and beauty, should not be overlooked.

Some of the important cultivated soils of the county are subject to damage from soil blowing. Included in this group are soils of the Cass, Ortello, Thurman, and Wann series. Well-planned field windbreaks combined with good cropping practice keep soil blowing damage to a minimum.

Trees grow well in Polk County if a few basic rules are observed. A healthy tree of a species suited to the area will do well if properly planted on a prepared site. Cultivation to control weeds and grass is needed until the trees are large enough to shade out the area.

The most desirable trees for windbreak plantings are native conifers, such as eastern redcedar, ponderosa pine, and Rocky Mountain juniper. If broadleaf trees and shrubs are used, those species native to Nebraska are generally more satisfactory than introduced species. Native broadleaf species well suited to this area are honeylocust, hackberry, green ash, chokeberry, and American plum. Some of the introduced broadleaf shrubs, such as the bush honeysuckles, cotoneaster, and lilac also do well.

Some trees that make an early, fast growth tend to be short lived. This is true of cottonwood. Siberian elm grows vigorously but is undesirable because it can spread to adjoining fields and lots. American elm is a poor choice because of its susceptibility to Dutch elm disease. Russian-olive is relatively short lived and spreads in

Figure 22.—**Well-managed farmstead windbreak on Hord silt loam.**

overflow areas. Care is needed in the choice of trees for windbreak plantings.

The growth rate of trees in windbreaks varies widely with soil conditions and tree species. The rate is influenced greatly by available moisture, soil fertility, exposure, and arrangement of tree species within the planting. Eastern redcedar generally grows slightly less than 1 foot per year in height. At maturity it normally reaches a height of 30 to 40 feet. Pines and broadleaf trees grow somewhat faster and are generally taller at maturity.

Table 3 gives the expected height of trees suitable for windbreak plantings in this county at 20 years of age. Detailed tree measurements were taken on the soils of the major windbreak groups occurring in the county. The soils included within each group are listed in the description of the groups. The soils in each group are similar in the characteristics that affect tree growth.

A good windbreak planting should be designed according to intended purpose of the planting. Specific information on design, planting, and care of the windbreak is available from the Soil Conservation Service and Extension Service representatives serving the county.

Descriptions of windbreak groups

The soils of Polk County are grouped according to characteristics that affect tree growth. The names of the soil series represented are mentioned in the description of each group but this does not mean that all the soils of a given series are in the group. To find the names of all the soils in any given group, refer to the "Guide to Mapping Units" at the back of this survey. The soils in a group produce similar growth and survival of trees under normal conditions of weather and care. Following is a brief description of the windbreak groups in Polk

TABLE 3.—*Relative vigor and estimated height, by windbreak group, of specified trees at 20 years of age*[1]

Windbreak group	Eastern redcedar		Ponderosa pine		Green ash		Hackberry		Honeylocust		Cottonwood	
	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height	Relative vigor	Average height
		Ft.		*Ft.*		*Ft.*		*Ft.*		*Ft.*		*Ft.*
Silty to clayey	Excellent	22	Excellent	27	Excellent	27	Excellent	26	Good	29	Unsuited	(2)
Sandy	Excellent	23	Excellent	30	Good	27	Unsuited	(2)	Fair	29	Good	54
Very sandy	Excellent	17	Excellent	25	Unsuited	(2)	Unsuited	(2)	Unsuited	(2)	Unsuited	(2)
Moderately wet	Excellent	21	Unsuited	(2)	Good	29	(3)	(3)	Good	34	Good	54
Shallow	Excellent	15	Excellent	20	Unsuited	(2)	Unsuited	(2)	Unsuited	(2)	Unsuited	(2)

[1] Very Wet and Moderately Saline-Alkali groups are not included because the need for windbreaks is uncommon.

[2] Not applicable.

[3] Sufficient data unavailable.

County and a list of suitable trees and shrubs for windbreak plantings in each group.

SILTY TO CLAYEY WINDBREAK GROUP

This group consists of well-drained to somewhat poorly drained, nearly level to very steep soils on bottom lands, stream terraces, and uplands. These soils have a medium-textured to moderately fine textured surface layer and subsoil. The underlying material is medium textured. In this group are soils of the Butler, Cozad, Coly, Hall, Hastings, Hobbs, Holder, Hord, and Leshara series and Rough broken land, loess.

These soils are generally good tree-planting sites that provide for good survival and growth of adapted species. Drought and moisture competition from weeds and grass are the main hazards. Water erosion is a hazard in sloping areas. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, Scotch pine
Low broadleaf—Russian mulberry, Russian-olive
Tall broadleaf—hackberry, honeylocust, bur oak, green ash
Shrubs—lilac, honeysuckle, cotoneaster, chokecherry, American plum

SANDY WINDBREAK GROUP

This group consists of deep to moderately deep, well-drained to excessively drained, nearly level to steep soils on stream terraces and uplands. The surface layer, subsoil, and underlying material are moderately coarse textured to coarse textured. In this group are soils of the Blendon, Cass, Darr, Inavale, O'Neill, Ortello, and Thurman series.

These soils are suited to tree plantings if soil blowing is controlled by maintaining strips of sod or other vegetation between the tree rows. Cultivation should be restricted to the tree rows. Drought and moisture competition from grass and weeds are hazards. Water erosion is a hazard in sloping areas. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine, Scotch pine
Low broadleaf—Russian mulberry, Russian-olive
Tall broadleaf—honeylocust, green ash
Shrubs—lilac, cotoneaster, skunkbush sumac, American plum

VERY SANDY WINDBREAK GROUP

Only one soil, Thurman loamy sand, 5 to 11 percent slopes, is in this group. It is a deep, somewhat excessively drained, gently sloping to moderately sloping soil on stream terraces. The surface layer and underlying material are coarse textured.

This soil is so loose that trees have to be planted in shallow furrows and not cultivated. Young seedlings can be blown over during high winds. They can also be covered by drifting sand. The following trees are suitable for planting.

Conifers—eastern redcedar, ponderosa pine, Rocky Mountain juniper, Austrian pine, Scotch pine

MODERATELY WET WINDBREAK GROUP

This group consists of deep, moderately deep and shallow, well-drained to poorly drained soils on bottom land, uplands, and in upland depressions. The surface layer is moderately fine textured to moderately coarse textured and the subsoil is fine textured to moderately coarse textured. The underlying material is medium textured to very coarse textured. In this group are soils of the Alda, Fillmore, Hobbs, Lamo, Leshara, Platte, and Wann series and Silty alluvial land.

These soils are good tree-planting sites if the species selected can tolerate occasional wetness. Establishment of trees can be difficult in wet years. Cultivation between the rows is also a concern. The abundant and persistent herbaceous vegetation growing on these sites competes for moisture in the tree rows. The following trees and shrubs are suitable for planting.

Conifers—eastern redcedar, Austrian pine
Tall broadleaf—honeylocust, green ash, white willow, golden willow, cottonwood
Shrubs—red-osier dogwood, silver buffaloberry, chokeberry, American plum

VERY WET WINDBREAK GROUP

This group consists of shallow to deep, very poorly drained to poorly drained, nearly level soils on bottom lands. The surface layer is moderately fine textured to coarse textured and the underlying material is coarse textured to very coarse textured. In the group are Wet alluvial land and Sandy alluvial land.

Only those trees and shrubs that are tolerant of a high water table are suitable for planting.

Low broadleaf—diamond willow
Tall broadleaf—white willow, golden willow, cottonwood
Shrubs—red-osier dogwood, silvery buffaloberry

MODERATELY SALINE-ALKALI WINDBREAK GROUP

These deep, well-drained, nearly level soils are on stream terraces. The surface layer is medium textured, and the subsoil is medium textured or moderately fine textured. Only one mapping unit is in this group, the Cozad-Slickspots complex, terrace. It is about 30 percent Slickspots, which are areas moderately affected by salinity and alkalinity.

Establishment of trees can be difficult in wet years. Cultivation between the rows can also be difficult because of wetness. These soils are suited to the following trees, which are tolerant of moderate concentrations of salts or alkali.

Conifers—Rocky Mountain juniper, eastern redcedar, ponderosa pine, Austrian pine
Tall broadleaf—green ash, honeylocust, cottonwood
Low broadleaf—Russian-olive
Shrubs—skunkbush sumac, buffaloberry

SHALLOW WINDBREAK GROUP

This group consists of a shallow, excessively drained, nearly level to gently sloping soil on stream terraces. The surface layer and transitional layer are coarse textured. The underlying material is a mixture of sand and gravel. There is only one soil in this group, Meadin loamy sand, 0 to 5 percent slopes.

A limited root zone and low available water capacity are the main hazards on this site. Drought is a hazard in most years. The only species suitable for planting is the conifer, eastern redcedar.

Management of the Soils for Wildlife [5]

Wildlife management requires a knowledge of soils and the kind of vegetation they are capable of producing. The kind, amount, and distribution of vegetation largely determine the kinds and numbers of wildlife that can be produced and maintained.

Fertility and soil characteristics, such as topography, affect the wildlife carrying capacity of an area. Fertile soils generally produce more wildlife. Waters drained from such soils usually produce more fish than those from infertile soils.

Soil topography affects wildlife through its influence on how land can be used. Rough, steep land presents hazards to livestock and is impractical to cultivate for crop production. Undisturbed vegetation on these sites is valuable for wildlife, and where such cover is lacking, it can often be established.

Permeability and rate of water infiltration are important soil characteristics in the construction of ponds for fish and in developing and maintaining wetland habitat for waterfowl (fig. 23). Marshy areas are suited to the development of aquatic and semiaquatic habitat for waterfowl and some species of furbearers.

The soils of Polk County provide suitable habitat for many species of game and nongame birds and mammals. It may seem strange that those soils that have the largest wildlife populations do not rate highest in the potential for producing wildlife. The reason for this is that the better farming soils are intensively managed for maximum crop yields rather than for wildlife.

The Hastings and Holder soil associations, in the southern half of the county, provide some of the best habitat for pheasants. Corn, sorghum, wheat, and alfalfa crops provide an excellent supply of food for this species, and wheatfields provide nesting areas that are generally undisturbed until after the peak of the pheasant hatch has passed.

Topography in these associations is nearly level to moderately sloping, and odd areas suitable for producing permanent wildlife cover are scarce. Fields are generally large, and good interspersion of different habitat types is lacking. Soils of the Holder association provide sites for constructing dams and creating ponds. Some of these ponds are suitable for producing fish, but the amount of clay held in suspension in the water is often a limitation of concern to management.

Most of the Thurman-Meadin association is in native grass and is used for grazing cattle. Only a small acreage is cultivated. Proper use of this grassland is important to wildlife. Where the soils are used within their capability, cover is produced that is valuable for wildlife habitat.

Another important fishery in Polk County is located in the Platte-Leshara-Alda association along the Platte River. Sandpits provide good pond fishing for bluegill, bass, and crappie. The bottom woodland of this association provides food and cover for a number of nongame and game species. The latter includes deer, bobwhite quail, pheasants, squirrels, and cottontail rabbits. Furbearers, such as mink and muskrat, also inhabit this area. The marshy areas and the river channels are used by waterfowl, mainly during spring and fall migrations. The potential for outdoor recreational development in this association is high.

Wildlife habitat is a product of soil and water, and each individual area has a certain capacity for the production of these resources. Where grassland is put into crop production there is a loss of cover for some kinds of animals, but in turn, an improved food supply is made available to others.

The Big Blue River in the Hastings and Hord associations provides good fishing for catfish, bullhead, and carp. Wooded tracts along streams in this bottom land provide habitat for deer, bobwhite, quail, squirrels, and cottontail rabbits. These associations are 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 other furbearers, such as raccoon, opossum, and coyote. The water and marshy areas are also used by waterfowl, chiefly during the spring and fall migration periods.

[5] Prepared by ROBERT J. LEMAIRE, conservation biologist, and JAMES W. CARR, JR., forester, Soil Conservation Service.

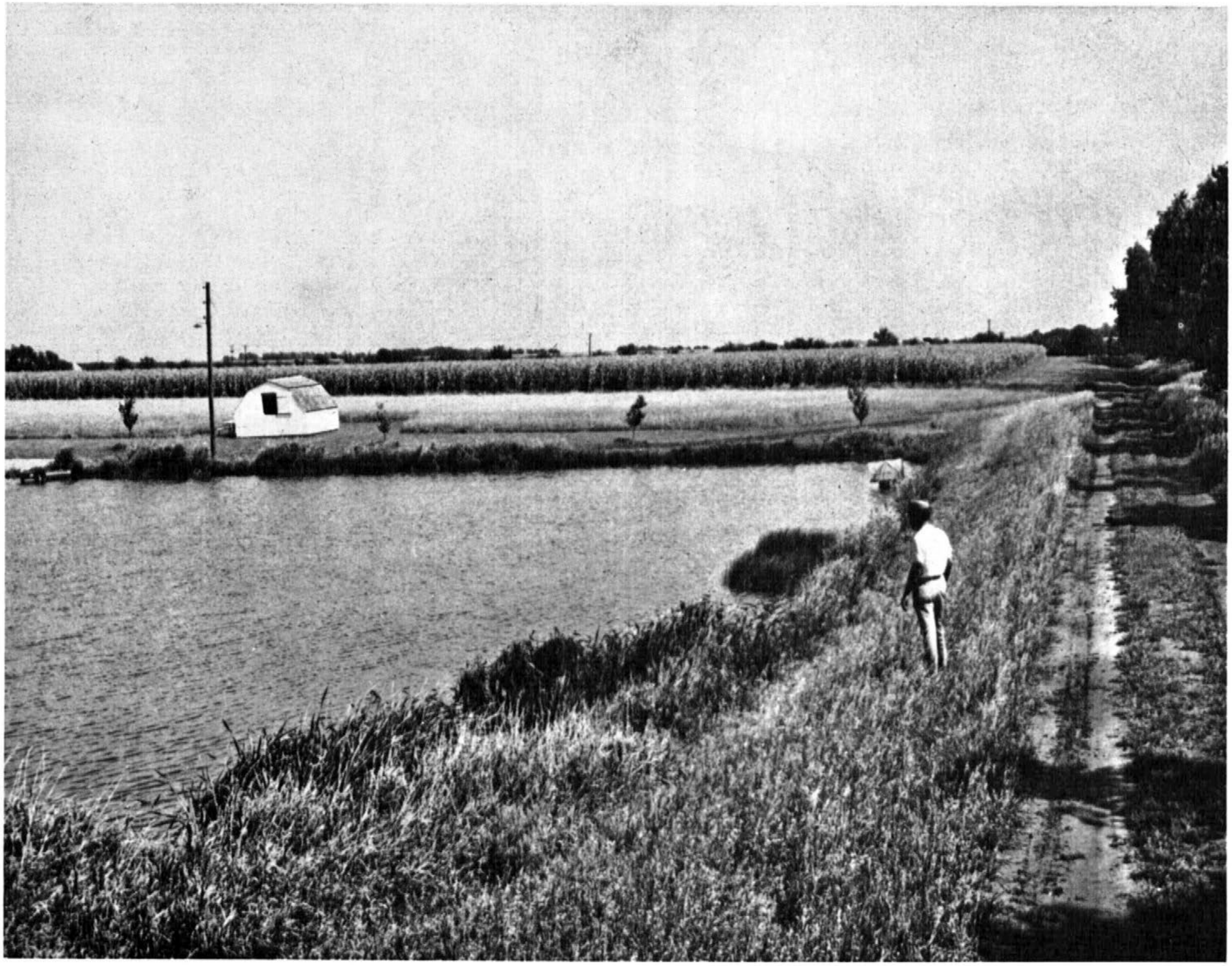

Figure 23.—**Farm pond, in a Holder soil, used for fishing, boating, picnicking, and other recreation.**

Because so much outdoor recreation is water oriented, the Big Blue River offers possibilities for recreation developments. Unfortunately, the soils near the river are among the poorest in the county for building sites or for developing outdoor recreational activities. The hazard of flooding is a limiting factor that needs to be considered in developing recreational sites in this area.

The Coly-Cozad association is on upland breaks to the Platte River Valley. Nearly all of this association is steep and in native grass. The draws that dissect this association support a limited amount of woody cover. Proper management of grazing livestock on the native grass is important to wildlife. The chief game species include deer, bobwhite quail, pheasant, squirrel, and cottontail rabbit.

The Hord association in the northern part of the county is nearly all cultivated. These highly productive soils furnish good food and cover for a number of wildlife species.

Where trees and shrubs are planted for field and farmstead windbreaks, another requirement of some species of wildlife is met. Construction of farm ponds can provide additional opportunities for improving habitat for wildlife. Herbaceous and woody plantings around ponds supply cover for wildlife and proper stocking and management of the ponds can produce sustained annual crops of fish.

Some areas of land are more suitable for wildlife production than for crops. By protecting existing natural cover, or by establishing needed cover, conditions can be improved for the production and maintenance of wildlife species.

Table 4 shows the suitability of the soils, by soil associations, for producing various kinds of vegetation and the relative importance of vegetative types for wood and cover for the important game species. Those vegetative types rated *high* or *medium* are considered essential habitat for that particular type of game.

TABLE 4.—*Soil associations rated for major kinds of wildlife habitat, and major wildlife habitat rated for kinds of game*

	Suitability for producing—			
	Woody plants	Herbaceous plants	Grain and seed crops	Aquatic habitat
Soil associations:				
Hastings	Well suited	Well suited	Well suited	
Holder	Well suited	Well suited	Well suited	
Coly-Cozad	Suited	Well suited	Suited to well suited	
Hord	Well suited	Well suited	Well suited	
Thurman-Meadin	Well suited to poorly suited.	Well suited to poorly suited.	Suited to unsuited	
Platte-Leshara-Alda	Well suited	Well suited	Well suited to poorly suited.	Suited.

	Wildlife habitat					
	Woody plants		Herbaceous plants		Grain and seed crops	
Kinds of game:	*Food*	*Cover*	*Food*	*Cover*	*Food*	*Cover*
Pheasant	Low	High	High	High	High	High.
Bobwhite quail	Low	High	High	High	High	Low.
Deer	High	High	Medium [1]	Low	High	Low.
Waterfowl					High [2]	

[1] Medium for white-tailed deer; high for mule deer.

[2] For dabbling ducks and geese, principally in spring and fall.

For the descriptions of the associations and their locations, refer to the section, "General Soil Map." The detailed information in that section names the soils in each association and indicates their use and management for the kinds of vegetation that can be produced. The ratings of *well suited*, *suited*, *poorly suited*, and *unsuited* in table 4 take into account the soils present and their characteristics with respect to potential for producing the kind of vegetation needed for wildlife.

Developing habitat for wildlife requires proper location and distribution of vegetation. Technical assistance in planning wildlife developments and determining which species of plants to use can be obtained from the Soil Conservation Service in Osceola, Nebr. Additional information and assistance can be obtained from the Nebraska Game and Parks Commission, from the Bureau of Sport Fisheries and Wildlife, and from the Federal Extension Service. The Soil Conservation Service provides technical assistance in planning and application of conservation practices for developing outdoor recreational facilities.

Engineering Evaluations of the Soils [6]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

[6] This section was prepared by JOHN E. OVERING, area engineer, and VERNON C. SEEVERS, 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.

Among the properties of soils highly important in engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to sand and gravel, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can help in determining—

1. Potential residential, industrial, commercial, residential, and recreational areas.
2. Alternate routes for roads, highways, pipelines, and underground cables.
3. Sites for farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
4. Sources of borrow material.
5. Information that can be useful in designing and maintaining engineering structures on different kinds of soil.
6. The suitability of soils for cross-country movement of vehicles and construction equipment.
7. Preliminary estimates for construction in a particular area.

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 in engineering, and interpretations for various engineering uses. Generally the soils in

Polk County are deep enough that bedrock does not affect their use.

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 6 and 7, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 5 feet. Also, inspection of sites, especially the small ones, 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.

Some of the terms used in this soil survey have special meaning to soil scientists that is not known to all engineers. The Glossary defines many of the terms commonly used in soil science.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*12*) used by the SCS engineers, Department of Defense, and others, and the AASHO system adopted by the American Association of State Highway Officials.

In the Unified system soils are classified generally as coarse grained, fine grained, and organic or peat. Fine-grained soils are classified according to plasticity characteristics, coarse-grained soils are classified primarily according to gradation, and organic soils according to odor and plasticity change after oven drying.

Combinations of letters are used to identify soil materials and certain properties in the Unified system. G is used for gravel, S for sand, C for clay, M for silt, W for well graded, P for poorly graded, L for low liquid limit, and H for high liquid limit.

Two letters are combined to classify the soil; for example, SP is a sand, poorly graded; CL is a clay of low plasticity; and GC is a gravel-clay mixture. There are twelve possible inorganic classifications and three possible organic classifications. Organic soils, including OL, OH, and peat (Pt), are uncommon in Polk County.

The soils of Polk County are classified in tables 5 and 6 as CL, CH, ML, ML–CL, SP, SP–SM, SW, SW–SM, and SM. Soils of the borderline between two classes are designated by symbols for both classes; for example, SW–SM.

The AASHO system (*1*) 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. A sand-silt-clay soil is further classified by identifying the silt-clay portion, thus, an A–2–4 soil is an A–2 sand with an A–4 type of silt-clay mixture included. 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 Nebraska Department of Roads uses a group index of –4 to 32 instead of 0 to 20. This enlarged group index bracket allows the plastic and nonplastic, fine-grained soil occurring in sands to be evaluated and the effect of a high clay content (group index greater than 20) to be determined.

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 shown in table 6 for all soils mapped in the county.

Engineering test data

Table 5 shows engineering test data for some of the major soil series in the county. The data shown are helpful in evaluating the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods. Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material.

Compaction, or moisture-density, data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

The plastic limit is the moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the soil passes from a solid to a plastic state. Liquid limit is the moisture content at which the soil passes from a plastic to a liquid state. The plasticity index is the numerical difference in percent of moisture between the liquid limit and plastic limit. It indicates a range of moisture content within which soil is in a plastic condition. Some silty and sandy soils are nonplastic, which means they will not become plastic at any moisture content.

Engineering properties of soils

In table 6 soil properties significant in engineering are estimated. For detailed information about the soils, refer to the section "Descriptions of the Soils," and for information about geology, to the section "Formation and Classification of the Soils."

The estimates in table 6 were based on the engineering test data in table 5 and on other information obtained in the county during the survey. The data are listed by strata that have properties significant in engineering. These data include the textural classification of the United States Department of Agriculture and the AASHO and Unified engineering classifications. Also listed for each layer are the percentages of material that will pass a No. 4, 10, 40, and 200 sieve, and the percent finer than 0.002 millimeter as determined by the hydrometer method. Estimates of the percentage passing the sieves are based on the assumption that material up to and including 3 inches in diameter equals 100 percent. There are no soils in Polk County that have a significant percentage of coarse materials greater than 3 inches.

In the AASHO and Unified systems, soil particles retained on the No. 200 sieve are classed as sand and gravel. Silt and clay particles will pass through this sieve. Particles retained on the No. 4 sieve are classed as gravel. The range of values shown in table 6 for the percent of soil finer than 0.002 millimeter represents the estimated clay fraction of the soil. Silt and clay particles can affect such properties as strength, permeability, compaction, and shrink-swell potential.

In tables 5 and 6 the clay percentage is based on an analysis which uses the hydrometer method (AASHO Designation T–88). This can give results that differ slightly from those obtained with the pipette method used by SCS soil scientists to obtain results with standard soil survey procedures.

In table 6, permeability refers to the rate at which water moves through a saturated soil. It depends largely on gradation, structure, and density. The rate is given in inches of water per hour. Rates are given for the major significant soil horizons. Terms used to describe permeability and the equivalent rates are given in the Glossary.

Available water capacity, estimated in inches of water per inch of soil depth, is the approximate amount of capillary water in a soil that is wet to field capacity. When soil is air dry, this amount of water will wet it to a depth of 1 inch without deeper percolation.

Soil dispersion is not a serious problem because few areas contain enough salts to produce moderate dispersion. Salinity is generally not a problem. However, in the somewhat poorly drained bottom land soils along the Platte River, some areas are saline. Onsite investigations need to be made in all areas where salinity poses a hazard to construction work.

A generalized rating for shrink-swell potential is given as *high*, *moderate*, *low*, or *very low*. Several soils, such as those in the Butler and Fillmore series, have moderate to high shrink-swell potential. Generally, soils with a high clay content undergo a volume change when the soil moisture is changed. Clean sands and gravels undergo little or no volume change when wetting or drying occurs.

Engineering interpretations of soils

The estimated interpretations in table 7 are based on the engineering properties of soils shown in table 6, on test data for soils in Polk County, and on the experience of engineers and soil scientists with the soils of the county. In table 7, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties generally favorable for the rated use, or in other words, limitations that are minor and easily overcome. *Moderate* means that some soil properties are unfavorable, but the limitation can be overcome or modified by special planning and design. *Severe* means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation and special designs.

Soil suitability is rated by the terms good, fair, and poor, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe. Some specific soil properties that affect soil suitability are evaluated as high, moderate, or low also.

Following are explanations of some of the columns in table 7.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or its response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability.

Sand or mixed sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet.

Soil properties that most affect location, design, and construction of roads and highways are load supporting capacity and stability of the subgrade, workability, and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material, and also the shrink-swell potential, indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to sand and gravel, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Road fill is soil material used in embankments for roads and foundation for embankments. The suitability ratings reflect limitations concerning erodibility of cut slopes, potential frost action, and compaction characteristics.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for these areas have low seepage, which is related to their permeability and depth over sand and gravel. Soils with a high water table may be good sites for excavating a dugout for water. A deep water table may indicate the need for sealing or lining a pond.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, compactibility, and workability. The latter includes ease of hauling. Erodibility and steepness in a soil are among factors that are unfavorable. Sandy dikes and levees are subject to wind and water erosion and to horizontal seepage. The steeper clay soils that are not subject to shrinkage and cracking as they dry are the most suitable for dikes and levees.

Foundations are generally rated on bearing, or load-carrying, capacity. Most soils have a high bearing capacity when dry. Some of the windblown soils are subject to high consolidation when saturated under load. Sands and gravels (see AASHO classifications) have high bearing capacity when confined. Specific values for bearing capacity (for example, pounds per square inch) should not be assigned to estimated values as expressed in words in table 7. Wet excavations for buildings may be a problem. Therefore, depth to water should be determined for building sites. The potential for shrink swell from table 6 is important also to foundations.

TABLE 5.—*Engineering*

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

Soil name and location	Parent material	Report number	Depth	Moisture density [1]	
				Maximum dry density	Optimum moisture
			In.	*Lb./cu. ft.*	*Pct.*
Cass fine sandy loam:					
0.25 mile east and 125 feet south of the northwest corner of section 11, T. 16 N., R. 1 W. (Modal profile.)	Alluvium.	S65–2933	0–8	119	10
		S65–2934	20–33	----------	----------
		S65–2935	33–50	115	11
Fillmore silt loam:					
0.2 mile south and 75 feet east of the northwest corner of section 22, T. 13 N., R. 2 W. (Modal profile.)	Peoria loess.	S65–2936	0–9	103	16
		S65–2937	9–14	106	15
		S65–2938	17–34	----------	----------
		S65–2939	42–65	----------	----------
Hastings silt loam:					
0.2 mile west and 100 feet north of the southeast corner of section 32, T. 13 N., R. 2 W. (Maximal development.)	Peoria loess.	S65–2940	0–7	----------	----------
		S65–2941	17–28	----------	----------
		S65–2942	33–60	----------	----------
Hobbs silt loam:					
0.35 mile north and 300 feet east of the southwest corner of section 14, T. 13 N., R. 1 W. (Modal profile.)	Alluvium.	S65–2943	0–8	----------	----------
		S65–2944	26–46	----------	----------
Holder silt loam:					
0.15 mile west and 250 feet north of the southeast corner of section 36, T. 15 N., R. 3 W. (Modal profile.)	Peoria loess.	S65–2945	0–6	----------	----------
		S65–2946	14–24	----------	----------
		S65–2947	29–66	----------	----------
Inavale loamy fine sand:					
250 feet west and 20 feet north of the southeast of corner of section 28, T. 16 N., R. 2 W. (Modal profile.)	Alluvium.	S65–2956	0–11	113	11
		S65–2957	11–20	----------	----------
		S65–2958	20–49	107	13
Lamo silty clay loam:					
0.5 mile south and 40 feet west of the northeast corner of section 11, T. 16 N., R. 1 W. (Modal profile.)	Alluvium.	S65–2948	0–7	100	20
		S65–2949	20–29	----------	----------
		S65–2950	34–42	----------	----------
Leshara silt loam:					
0.5 mile west and 50 feet north of the southeast corner of section 22, T. 16 N., R. 1 W. (Modal profile.)	Alluvium.	S65–2951	0–7	----------	----------
		S65–2952	13–20	----------	----------
		S65–2953	20–46	----------	----------
Platte fine sandy loam:					
500 feet east and 200 feet north of the southwest corner of section 34 T. 16 N., R. 2 W. (Modal profile.)	Alluvium.	S65–2954	0–7	109	15
		S65–2955	13–42	----------	----------

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

[2] Mechanical analysis according to AASHO Designation: T88–57(*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey

test data

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

Mechanical analysis [2]											Liquid limit	Plasticity index	Classification	
Percentage passing sieve—							Percentage smaller than—						AASHO	Unified
¾-in.	⅜-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
------	------	------	100	92	78	35	22	10	5	5	[3] NP	[3] NP	A-2-4(0)	SM
------	------	------	100	93	82	54	31	13	6	6	18	NP	A-4(4)	ML
------	------	------	100	91	74	20	13	6	5	4	NP	NP	A-2-4(0)	SM
------	------	------	------	100	100	99	80	34	15	11	25	NP	A-4(8)	ML
------	------	------	100	99	99	99	90	40	16	10	23	1	A-4(8)	ML
------	------	------	------	100	100	99	92	68	47	44	51	31	A-7-6(18)	CH
------	------	------	------	100	100	99	91	43	22	19	33	9	A-4(8)	ML-CL
------	------	------	------	100	------	99	86	50	28	22	32	10	A-4(8)	ML-CL
------	------	------	------	100	------	99	92	66	48	45	57	34	A-7-6(18)	CH
------	------	------	------	100	------	99	91	56	37	30	44	24	A-7-6(14)	CL
------	------	------	------	100	------	99	92	42	26	21	33	11	A-6(8)	ML-CL
------	------	------	------	100	------	99	90	60	28	11	44	16	A-7-6(11)	ML-CL
------	------	------	------	100	------	98	78	42	27	20	33	10	A-4(8)	ML-CL
------	------	------	------	100	------	99	86	60	42	35	49	25	A-7-6(16)	CL
------	------	------	------	100	------	100	82	52	32	29	42	22	A-7-6(13)	CL
------	------	------	100	81	59	20	12	4	2	2	NP	NP	A-2-4(0)	SM
------	------	------	100	71	48	9	6	2	2	2	NP	NP	A-3(0)	SW-SM
------	------	100	99	82	55	10	6	2	1	1	NP	NP	A-3(0)	SW-SM
------	------	------	100	99	97	90	76	40	25	18	40	15	A-6(10)	ML-CL
------	------	------	100	99	96	82	71	53	38	32	43	26	A-7-6(15)	CL
------	------	------	100	99	98	66	40	12	5	4	22	NP	A-4(6)	ML
------	------	------	100	92	78	54	44	22	13	10	21	2	A-4(4)	ML
------	------	------	100	88	73	53	44	26	16	12	28	10	A-4(4)	CL
------	------	------	100	95	90	83	70	44	24	18	35	15	A-6(10)	CL
------	------	------	100	89	81	58	42	16	7	5	29	5	A-4(5)	ML-CL
100	99	95	88	50	29	4	1	0	0	0	NP	NP	A-1-b(0)	SW

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-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes for soils.

[3] Nonplastic.

TABLE 6.—*Estimates of 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 for referring to other series that appear in the first

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Mixed sand and gravel	Seasonal high water table		USDA texture	Unified [1]	AASHO [1]
	Ft.	*Ft.*	*In.*			
Alda: Ax, Ay	1½–3	2–6	0–29	Fine sandy loam	SM or ML	A–2 or A–4
			29–60	Sand and gravel	SP–SM, SP, or SM	A–1 or A–2
Blendon: Bdn, BdnA	5–20	>10	0–20	Fine sandy loam	SM or ML	A–2 or A–4
			20–56	Fine sandy loam	SM or ML	A–2 or A–4
			56–60	Silt loam	ML or CL	A–4 or A–6
Butler: Bu	>10	>10	0–12	Silt loam	ML or CL	A–4 or A–6
			12–32	Silty clay	CH	A–7
			32–41	Silty clay loam	CL	A–6 or A–7
			41–60	Silt loam	ML or CL	A–4 or A–6
Cass: Ca	3–6	6–15	0–33	Fine sandy loam	SM or ML	A–2 or A–4
			33–55	Loamy sand	SM	A–2
			55–60	Sandy loam	SM	A–2
Coly: CbD	>10	>10	0–10	Silt loam	ML or CL	A–4 or A–6
			10–60	Silt loam	ML or CL	A–4 or A–6
*Cozad: CozB, CozC, 2Coz, 2CozA, 2CozB, CosB3, CosC3, CS. For Slickspots part of CS, local determination is needed.	([3])	10	0–12	Silt loam	ML or CL	A–4 or A–6
			12–32	Silt loam	ML or CL	A–4 or A–6
			32–60	Silt loam	ML	A–4
Darr: Da	1½–3	6–15	0–25	Fine sandy loam	SM or ML	A–4 or A–2
			25–33	Fine sand	SM, SP–SM, or SP	A–2 or A–3
			33–60	Sand and gravel	SP, SM, or SP–SM	A–1 or A–2
Fillmore: Fm	>10	>10	0–14	Silt loam	ML or CL	A–4 or A–6
			14–42	Silty clay	CH	A–7
			42–60	Silt loam	ML or CL	A–4 or A–6
Gravel pits: GP	0					
Hall: Ha	5–20	>10	0–14	Silt loam	ML or CL	A–4 or A–6
			14–36	Silty clay loam	CH or CL	A–7 or A–6
			36–60	Silt loam	ML or CL	A–4 or A–6
Hastings: Hs, HsA, HsB, HnB3, HnC3.	>10	>10	0–12	Silt loam	ML or CL	A–4 or A–6
			12–39	Silty clay loam	CH or CL	A–6 or A–7
			39–60	Silt loam	CL	A–6
Hobbs: 2Hb, HbA, HbB	>10	>10	0–20	Silt loam	ML or CL	A–4 or A–6
			20–60	Silt loam	ML or CL	A–4 or A–6
Holder: Hg, HgA	>10	>10	0–14	Silt loam	ML or CL	A–4 or A–6
			14–31	Light silty clay loam	CL	A–6 or A–7
			31–60	Silt loam	ML or CL	A–4 or A–6
Hord: Hd	([4])	>10	0–30	Silt loam	ML or CL	A–4 or A–6
			30–60	Very fine sandy loam	ML	A–4
*Inavale: IbB, Ig, IP. For Platte part of IP, see Platte series.	6–20	6–20	0–20	Loamy fine sand	SM or SW–SM	A–2
			20–60	Loamy sand	SP–SM, SM, or SW–SM	A–2 or A–3
Lamo: 2Lb	1½–6	2–6	0–29	Silty clay loam	ML or CL	A–6 or A–7
			29–42	Very fine sandy loam	ML	A–4
			42–60	Sand and gravel	SM, ML or SP	A–3 or A–2

See footnotes at end of table.

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such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions column of this table. Symbol> means more than]

Percentage passing sieve—				Material finer than 0.002 mm.	Permeability	Available water capacity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
				Pct.	*In./hr.*	*In./in. of soil*	
100	98–100	96–100	20–85	3–15	2. 00–6. 30	0. 16–0. 18	Low.
70–95	30–60	15–40	4–15	0–3	6. 30–20. 0	0. 02–0. 04	Very low.
100	98–100	82–98	18–57	3–15	2. 00–6. 30	0. 16–0. 18	Low.
100	98–100	82–98	18–57	5–12	2. 00–6. 30	0. 15–0. 17	Low.
100	98–100	95–100	85–100	18–27	0. 63–2. 00	0. 20–0. 22	Low to moderate.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 22–0. 24	Moderate.
100	98–100	85–100	89–100	40–60	0. 06–0. 20	0. 11–0. 13	High.
100	89–100	93–100	80–100	27–40	0. 20–0. 63	0. 18–0. 20	Moderate.
100	89–100	95–100	85–100	8–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	85–95	18–57	3–15	2. 00–6. 30	0. 16–0. 18	Low.
100	93–100	65–95	10–25	3–10	2. 00–6. 30	0. 08–0. 10	Low.
93–100	89–100	75–95	10–43	3–15	6. 30–20. 0	0. 11–0. 13	Low.
100	100	95–100	90–100	10–27	0. 63–2. 00	0. 22–0. 24	Low.
100	100	95–100	90–100	10–27	0. 63–2. 00	0. 20–0. 22	Low.
100	98–100	95–100	70–100	10–22	0. 63–2. 00	0. 22–0. 24	Moderate.
100	98–100	95–100	70–100	15–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	95–100	70–100	8–20	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	85–95	18–57	3–15	2. 00–6. 30	0. 16–0. 18	Low.
100	99–100	85–100	4–20	3–15	6. 30–20. 0	0. 06–0. 08	Low.
90–100	75–95	15–60	4–15	0–3	>20. 0	0. 02–0. 04	Very low.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 22–0. 24	Low to moderate.
	100	93–100	89–100	40–60	0. 06–0. 20	0. 11–0. 13	High.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 20–0. 22	Low to moderate.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 22–0. 24	Moderate.
100	98–100	93–100	90–100	27–40	0. 20–0. 63	0. 18–0. 20	Moderate to high.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 20–0. 22	Low to moderate.
100	98–100	95–100	95–100	10–27	0. 63–2. 00	0. 22–0. 24	Moderate.
100	98–100	93–100	90–100	30–40	0. 20–0. 63	0. 18–0. 20	Moderate to high.
100	98–100	95–100	85–100	20–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 22–0. 24	Low to moderate.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 20–0. 22	Moderate.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 22–0. 24	Low to moderate.
100	98–100	93–100	90–100	25–35	0. 63–2. 00	0. 18–0. 20	Moderate.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 20–0. 22	Low to moderate.
100	98–100	95–100	85–100	10–27	0. 63–2. 00	0. 22–0. 24	Low to moderate.
100	98–100	75–95	55–73	10–20	0. 63–2. 00	0. 17–0. 19	Low.
100	98–100	70–85	10–20	0–7	6. 30–20. 0	0. 10–0. 12	Low.
100	93–100	70–85	5–15	0–5	6. 30–20. 0	0. 08–0. 10	Low.
100	98–100	93–100	80–100	27–40	0. 20–0. 63	0. 21–0. 23	Moderate.
100	98–100	75–100	55–73	5–20	0. 63–2. 00	0. 17–0. 19	Low.
100	98–100	85–100	4–29	0–3	0. 63–>20. 0	0. 02–0. 19	Very low.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Mixed sand and gravel	Seasonal high water table		USDA texture	Unified [1]	AASHO [1]
	Ft.	*Ft.*	*In.*			
Leshara: Le, 2Le	3-6	2-6	0-46	Silt loam	ML or CL	A-4 or A-6
			46-60	Sandy loam	SM	A-2
Meadin: MdB	1-2	>10	0-17	Loamy sand	SM	A-2
			17-60	Sand and gravel	SP, SW, or SP-SM	A-1 or A-2
O'Neill: On	1½-3	>10	0-16	Fine sandy loam	SM or ML	A-2 or A-4
			16-31	Loamy fine sand	SM	A-2
			31-60	Sand and gravel	SP, SM, or SP-SM	A-2 or A-3
*Ortello: OrC, OrC2, OxD. For Coly part of OxD see Coly series.	>10	>10	0-10	Fine sandy loam	SM or ML	A-4
			10-60	Fine sandy loam	SM or ML	A-4
*Platte: Pf, PL. For Alda part of PL, see Alda series.	1-1½	2-5	0-16	Fine sandy loam	ML or SM	A-4 or A-2
			16-60	Sand and gravel	SW or SP	A-2 or A-1
Rough broken land, loess: RB. No valid estimates can be made.	>10	>10				
Sandy alluvial land: Sx. No valid estimates can be made.	0-3	0-3				
Silty alluvial land: Sy. No valid estimates can be made.	>10	>10				
Slickspots. Mapped only with Cozad soils. No valid estimates can be made for Slickspots.	6-20	>10				
Thurman: TcB, TcC	6-20	6-30	0-60	Loamy sand	SM	A-2
Wann: Wb	3-6	2-6	0-16	Fine sandy loam	SM or ML	A-2 or A-4
			16-60	Sandy loam	SM	A-2
*Wet alluvial land: Wx. Mapped only with Alda soils. For Alda part see Alda series. No valid estimates can be made for Wet alluvial land.						

[1] If two or more classifications are shown, the classification listed first is considered to be the most common.

[2] The figures for available water capacity are averages based on water retention difference as determined by laboratory tests. Studies are continuing.

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Percentage passing sieve— No. 4 (4.7 mm.)	Percentage passing sieve— No. 10 (2.0 mm.)	Percentage passing sieve— No. 40 (0.42 mm.)	Percentage passing sieve— No. 200 (0.074 mm.)	Material finer than 0.002 mm.	Permeability	Available water capacity [2]	Shrink-swell potential
				Pct.	*In./hr.*	*In./in. of soil*	
100	98–100	85–100	53–95	10–27	0. 63–2. 00	0. 20–0. 24	Low to moderate.
100	93–100	65–95	10–43	5–15	0. 63–2. 00	0. 20–0. 22	Low.
100	93–100	65–95	5–15	0–7	6. 30–20. 0	0. 10–0. 12	Low.
90–100	60–95	15–40	2–12	0–3	>20. 0	0. 02–0. 04	Very low.
100	98–100	85–95	18–57	5–20	2. 00–6. 30	0. 16–0. 18	Low.
	100	80–100	11–30	0–8	6. 30–20. 0	0. 09–0. 11	Low.
100	95–100	65–85	5–15	2–5	>20. 0	0. 02–0. 04	Very low.
100	98–100	82–98	18–57	3–15	2. 00–6. 30	0. 16–0. 18	Low.
100	98–100	82–98	18–57	5–12	2. 00–6. 30	0. 15–0. 17	Low.
100	98–100	85–95	18–58	5–20	2. 00–6. 30	0. 16–0. 18	Low.
93–100	80–90	30–60	2–5	0–3	6. 30–20. 0	0. 03–0. 14	Very low.
100	93–100	65–95	15–30	2–10	6. 30–20. 0	0. 08–0. 12	Low.
100	90–100	85–100	15–57	5–17	2. 00–6. 30	0. 16–0. 18	Low.
100	89–100	75–90	12–49	3–15	2. 00–6. 30	0. 14–0. 17	Low.

[3] 6 to 20 feet in valleys, 10 feet on uplands.

[4] 5 to 20 feet in valleys, greater than 10 feet on uplands.

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 referring to other series that appear

Soil series and map symbols	Suitability as source of—					Soil properties that affect suitability for—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved surface	Gravel surface			
Alda: Ax, Ay	Good	Good	Fair for surface layer; good below a depth of 30 inches.	Fair for surface layer; poor below a depth of 30 inches.	Fair for surface layer; good below a depth of approximately 30 inches.	Moderate susceptibility to frost action; water table at a depth of 2 to 6 feet.	Good bearing capacity for confined sand; water table at a depth of 2 to 6 feet.
Blendon: Bdn, BdnA.	Good	In places sand and gravel available below a depth of 5 feet.	Fair	Good to fair.	Fair to good if compaction control is adequate.	Erodibility of slopes; moderate to low susceptibility to frost action.	Good bearing capacity; low shrink-swell potential.
Butler: Bu	Fair: moderately thick surface layer.	([1])	Fair to poor.	Good to fair.	Fair if compaction control is adequate; shallow cuts; moderate to high shrink-swell potential.	High susceptibility to frost action; surface ponding requires minimum fills; erodibility of slopes.	Fair to poor bearing capacity; may be wet; may crack when dry; high shrink-swell potential.
Cass: Ca	Good	Good: sand below a depth of 3 feet.	Good to fair.	Good to fair.	Good	Moderate susceptibility to frost action; erodibility of slopes.	Fair bearing capacity; possible seepage.
Coly: CbD	Poor: thin surface layer; low natural fertility; slopes.	([1])	Fair to poor	Good	Fair if compaction control is adequate.	High susceptibility to frost action; deep cuts and high fills; erodibility of slopes; consolidation may be excessive.	Fair bearing capacity.
*Cozad: CosB3, CosC3, CozB, CozC, 2Coz, 2CozA, 2CozB, CS. Slickspots part of CS requires local determination.	Fair: moderately thick surface layer.	In places sand and gravel available below a depth of 6 feet.	Fair to poor.	Good	Fair: low to moderate shrink-swell potential.	Erodibility of slopes; high susceptibility to frost action; consolidation of foundation to be noted on site.	Fair bearing capacity; some steep grades.

See footnote at end of table.

interpretations

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions in the first column of this table]

Soil properties that affect suitability for—Continued						Degree and kind of soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
High seepage; water table at a depth of 2 to 6 feet; can be used for dugouts.	Erodibility of slopes; good stability; possible seepage.	Good internal drainage; water table at a depth of 2 to 6 feet.	Low available water capacity; adequate drainage necessary.	Erodibility of diversion slopes; sandy substratum at a depth within 2 to 3 feet; low fertility.	Erodibility; medium fertility in upper 2 to 3 feet of soil.	Severe: water table at a depth of 2 to 6 feet.	Severe: water table at a depth of 2 to 6 feet.
Moderate to high seepage.	Erodibility of slopes; good stability if compaction is controlled.	Good drainage	High available water capacity; erodibility.	Erodibility of diversion slopes; susceptible to siltation.	Erodibility	Slight	Severe: moderately rapid permeability; requires sealing or lining in some places.
Low seepage; may be used as excavated ponds.	Good to fair stability; impervious; fair workability; medium compressibility; erodibility of slopes.	Subject to occasional ponding; poor internal drainage.	High available water capacity; slow intake rate; adequate drainage necessary; slow permeability in subsoil.	Erodibility of diversion slopes.	Generally satisfactory.	Severe: slow permeability.	Slight.
Moderate to high seepage; water table at a depth of 6 to 15 feet.	Good stability; good workability; erodibility of slopes; control of seepage required in foundation in some places.	Good drainage	Moderate available water capacity; susceptible to soil blowing.	Erodibility of diversion slopes; sandy subsoil at a depth of less than 3 feet.	Erodibility; medium fertility.	Moderate: seepage rate may cause contamination of the underground water supply.	Severe: moderately rapid permeability; requires sealing or lining.
Moderate seepage.	Fair stability; fair workability; erodibility of slopes.	Good drainage; surface drainage excessive.	Not suitable	Erodibility; high siltation.	Erodibility of all slopes; medium fertility.	Severe: slopes.	Severe: slopes.
Moderate seepage.	Fair stability; erodibility of slopes; requires close control of compaction; fair workability.	Good drainage; excessive surface drainage on slopes.	High available water capacity; erodibility of steeper slopes.	Erodibility; topography may make desirable layout difficult.	Erodibility; medium fertility.	Moderate: moderate permeability and slopes.	Severe: slopes; moderate permeability; requires sealing or lining.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil properties that affect suitability for—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved surface	Gravel surface			
Darr: Da	Good to fair: sand and gravel at a depth of 20 to 40 inches.	Good: sand below a depth of 3 feet.	Fair for upper 2 feet; good below a depth of 2 feet.	Fair for upper 2 feet; poor below a depth of 2 feet.	Good: erodibility of slopes.	Erodibility of slopes; moderate susceptibility to frost action for surface soil; good locations for subsurface soil foundations.	Good bearing capacity; below a depth of 2 feet water table may cause seepage.
Fillmore: Fm	Fair: moderately thick surface layer.	(1)	Fair to poor.	Fair	Poor: high shrink-swell potential; high susceptibility to frost action.	Erodibility of slopes; high susceptibility to frost action; surface ponding requires minimum fills; close control of compaction is required.	Fair to poor bearing capacity; subsoil has high shrink-swell potential; subject to ponding.
Gravel pits: GP	Poor: very coarse textures.	Good.					
Hall: Ha	Good	(1)	Fair to poor.	Good	Fair: moderate to high shrink-swell potential; close control of compaction is required.	Erodibility of slopes; occasional overflow requires minimum fills; high susceptibility to frost action; close control of compaction is required.	Fair bearing capacity; depth of water table may cause seepage.
Hastings: HnB3, HnC3, Hs, HsA, HsB.	Good to fair, depending on location.	(1)	Fair to poor.	Good to fair.	Fair if compaction control is adequate.	Erodibility of slopes; susceptible to frost action.	Fair to poor bearing capacity; some steep grades.
Hobbs: 2Hb, HbA, HbB.	Good	(1)	Fair to poor.	Good to fair.	Fair: moderate susceptibility to frost action.	Erodibility of slopes; flooding requires minimum fills; susceptible to frost action; close control of compaction is required.	Fair bearing capacity; flooding possible.

See footnote at end of table.

interpretations—Continued

Soil properties that affect suitability for—Continued						Degree and kind of soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
High seepage; water table at a depth of 6 to 15 feet.	Good stability and workability; low compressibility; erodibility of slopes.	Somewhat excessive drainage.	Low available water capacity; susceptibility to soil blowing.	Erodibility of diversion slopes; medium fertility; sandy subsoil within a depth of 2 feet.	Erodibility; medium fertility; sand at a depth of 2 feet.	Severe: seepage rate may cause contamination of underground water supply.	Severe: moderately rapid permeability; requires sealing or lining.
Low seepage; can be used for excavated ponds.	Fair stability and workability; impervious; medium to high compressibility; erodibility of slopes.	Subject to ponding; poor internal drainage; outlets not always available.	High available water capacity; claypan subsoil; slow permeability.	Erodibility of diversion slopes.	No limitations.	Severe: slow permeability; subject to ponding.	Severe: subject to ponding.
Low seepage; high if sand is exposed; water table at a depth of 6 to 15 feet.	Fair stability if compaction is controlled; fair workability; medium compressibility; erodibility of slopes.	Good drainage; occasional overflow in some areas.	High available water capacity; occasional overflow.	Erodibility of diversion slopes.	No limitations.	Moderate: moderately slow permeability.	Moderate: moderately slow permeability; in places sealing or lining is required.
Low seepage in upper 3 feet.	Fair stability and workability; medium compressibility; impervious; erodibility of slopes.	Good drainage; moderately slow permeability; slopes excessively drained.	High available water capacity; erodibility of slopes.	Erodibility of cuts and fills.	Erodibility of steep slopes; high fertility.	Moderate: moderately slow permeability; slopes.	Moderate for cuts less than 3 feet and the lesser slopes; severe for steeper slopes.
Moderate seepage.	Erodibility of slopes; good to fair stability; close control of compaction is required; fair to good workability.	Good drainage; occasional overflow.	High available water capacity; flooding possible.	Erodibility of diversion slopes.	Erodibility of steep slopes; high fertility.	Severe: hazard of flooding.	Severe: flooding; moderate permeability.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil properties that affect suitability for—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved surface	Gravel surface			
Holder: Hg, HgA	Good	([1])	Fair to poor.	Good to fair.	Fair: moderate susceptibility to frost action; close control of compaction is required.	Erodibility of slopes; susceptible to frost action; close control of compaction is required; consolidation may be excessive.	Fair bearing capacity.
Hord: Hd	Good	([1])	Fair	Good to fair.	Fair to good: moderate susceptibility to frost action; close control of compaction is required.	Erodibility of slopes; susceptible to frost action; consolidation may be excessive.	Fair bearing capacity.
*Inavale: IbB, Ig, IP. For the Platte part of IP, see Platte series.	Poor: coarse texture.	Fair for sand; poor for gravel.	Good	Fair to poor.	Good	Erodibility of slopes; low susceptibility to frost action; may be difficult to place in fills.	Good bearing capacity if sand is confined.
Lamo: 2Lb	Fair: moderately thick surface layer.	Fair to good: water table at a depth of 2 to 6 feet.	Poor	Good	Fair to poor above a depth of 4 feet; water table at a depth of 2 to 6 feet.	Very high susceptibility to frost action; erodibility of slopes; high water table may require 4 to 7 feet fills.	Fair to poor bearing capacity above sand and gravel; good below; water table at a depth of 2 to 6 feet.
Leshara: Le, 2Le	Good to fair: water table at a depth of 2 to 6 feet in unit Le.	Fair to good: water table at a depth of 2 to 6 feet.	Fair to poor.	Good to fair.	Fair to good: water table at a depth of 2 to 6 feet in unit Le.	Very high susceptibility to frost action; high water table in unit Le requires minimum fills; erodibility of slopes.	Fair bearing capacity; water table at a depth of 2 to 6 feet in unit Le.
Meadin: MdB	Poor: coarse textures; shallow over sand and gravel.	Good for sand below a depth of 1½ feet; minor amounts of gravel.	Good	Poor	Good	Low susceptibility to frost action; erodibility of slopes; fills need to be confined; loading and hauling difficult.	Good bearing capacity if sand is confined.

See footnote at end of table.

interpretations—Continued

Soil properties that affect suitability for—Continued						Degree and kind of soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
Low seepage to a depth of about 5 feet.	Erodibility of slopes; fair stability; close control of compaction is required; fair to good workability.	Good drainage	High available water capacity; erodibility of steeper slopes.	Moderate erodibility of slopes.	Erodibility of steep slopes; high fertility.	Moderate: moderate permeability.	Severe: cuts exceeding a depth of 2½ feet expose material of moderate permeability.
Moderate seepage.	Erodibility of slopes; fair stability; close control of compaction is required; good workability.	Good drainage	High available water capacity.	Erodibility of diversion slopes.	High fertility	Moderate: moderate permeability.	Severe: permeability; requires sealing or lining.
High seepage	Good stability; erodibility of slopes.	Excessive internal drainage.	Low available water capacity; rapid intake rate; susceptible to soil blowing.	Not suitable	Erodibility; droughty; low fertility.	Moderate: seepage rate may cause contamination of underground water supply.	Severe: rapid permeability; lagoons require lining or sealing to function.
Low seepage; can be used for excavated ponds; water table at a depth of 2 to 6 feet.	Fair to poor stability and workability; moderate to high compressibility; water table at a depth of 2 to 6 feet.	Poor internal drainage; adequate outlets may not be available; water table at a depth of 2 to 6 feet.	High available water capacity; slow intake rate; adequate drainage is necessary.	Erodibility of diversion slopes; dense subsoil; water table at a depth of 2 to 6 feet.	Water table; sand and gravel at a depth of 3½ to 6 feet.	Severe: moderately slow permeability; water table at a depth of 2 to 6 feet.	Severe: water table at a depth of 2 to 6 feet.
Moderate to low seepage; water table at a depth of 2 to 6 feet in unit Le.	Good stability; moderate compressibility; water table at a depth of 2 to 6 feet in unit Le.	Fair to good internal drainage; adequate outlets may not be available; water table at a depth of 2 to 6 feet in unit Le.	High available water capacity; adequate drainage is necessary.	Erodibility of diversion slopes; water table at a depth of 2 to 6 feet in unit Le.	Erodibility; water table at a depth of 2 to 6 feet.	Severe: water table in unit Le at a depth of 2 to 6 feet.	Moderate: water table in unit Le at a depth of 2 to 6 feet.
High seepage	Erodibility of slopes; fair compaction characteristics and stability; highly pervious; low fertility.	Excessive internal drainage.	Very low available water capacity; rapid intake rate.	Erodibility of diversion slopes; sandy subsoil within a depth of 2 feet; low fertility.	Erodibility; low fertility; sand at a depth of 1½ feet.	Moderate: seepage contaminates underground water supply in places.	Severe: rapid permeability; requires sealing or lining to function as a lagoon.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil properties that affect suitability for—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved surface	Gravel surface			
O'Neill: On	Fair	Sand below a depth of 1½ feet.	Good	Fair	Good	Low to moderate susceptibility to frost action; erodibility of slopes; compaction control method to be determined for fills.	Good bearing capacity if sand is confined.
*Ortello: OrC, OrC2, OxD. For Coly part of OxD, see Coly series.	Fair for small amounts of sand.	Poor	Fair	Poor	Good	Susceptible to frost action if not drained; erodibility of slopes; slopes may require cuts and fills.	Good bearing capacity.
*Platte: Pf, PL. For Alda part of PL, see Alda series.	Poor: thin surface layer; shallow over sand and gravel.	Good: sand with a small percentage of gravel below a depth of 1 foot.	Good	Poor	Good	Low susceptibility to frost action; flooding and high water table require minimum fills; loose sand may be difficult to load.	Good bearing capacity if sand is confined; water table at a depth of 2 to 5 feet affects construction of footings.
Rough broken land, loess: RB. No interpretations. Material too variable.							
Sandy alluvial land: Sx. No interpretations. Material too variable.							
Silty alluvial land: Sy. No interpretations. Material too variable.							
*Slickspots. Mapped only with Cozad soils. No interpretations. Material too variable.							

See footnote at end of table.

interpretations—Continued

Soil properties that affect suitability for—Continued						Degree and kind of soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
High seepage	Good stability and workability; erodibility of slopes; moderately pervious.	Good drainage	Low available water capacity; fast intake rate; susceptible to soil blowing.	Erodibility of diversion slopes; very coarse underlying material within a depth of 2 feet; medium fertility.	Erodibility; medium fertility; in places cuts expose sand of low fertility.	Moderate: seepage contaminates underground water supply in places.	Severe: very rapid permeability of underlying material will not allow a lagoon to function.
Moderate seepage.	Erodibility of slopes; good workability; control of compaction is required.	Good drainage	Not suitable	Erodibility of slopes.	Medium fertility; erodibility; sandy soils in some channels.	Slight	Severe: moderately rapid permeability.
High seepage; can be used for dugouts.	Good stability; erodibility of slopes; highly pervious; subject to horizontal seepage.	Fair to good internal drainage; water table at a depth of 2 to 5 feet; subject to flooding; drainage is excessive if water table is lowered.	Low available water capacity; shallow; droughty if water table is lowered.	Erodibility of diversion slopes; sandy substratum within a depth of 2 feet; water table at a depth of 2 to 5 feet; low fertility.	Erodibility; low fertility; water table at a depth of 2 to 5 feet; sand and gravel at a depth of 1 to 1½ feet.	Severe: water table at a depth of 2 to 5 feet.	Severe: water table at a depth of 2 to 5 feet; very rapid permeability of underlying material.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as source of—					Soil properties that affect suitability for—	
	Topsoil	Sand or mixed sand and gravel	Road subgrade		Road fill	Highway location	Foundations
			Paved surface	Gravel surface			
Thurman: TcB, TcC.	Poor: coarse texture.	Fair for sand; poor for gravel.	Good	Poor	Good	Low susceptibility to frost action; high erodibility of slopes; loose sand may hinder loading.	Good bearing capacity if sand is confined; water table may interfere with construction below ground surface.
Wann: Wb	Good	Fair for sand at depths below 4 to 6 feet.	Good below a depth of 1½ feet.	Poor	Good	Low to medium susceptibility to frost action; water table at a depth of 2 to 6 feet; requires minimum fills; erodibility of slopes.	Fair to good bearing capacity; water table may interfere with construction of footing and cause seepage into foundation structure.
*Wet alluvial land: Wx. Mapped only with Alda soils. For Alda part, see Alda series. No interpretations for Wet alluvial land. Material too variable.							

[1] Sand and gravel are generally not available.

interpretations—Continued

Soil properties that affect suitability for—Continued						Degree and kind of soil limitations for sewage disposal	
Pond reservoir areas	Embankments, dikes, and levees	Agricultural drainage	Irrigation	Terraces and diversions	Grassed waterways	Filter fields	Sewage lagoons
High seepage	Good workability and stability if compaction is closely controlled; low compressibility; horizontal seepage may need control.	Excessive internal drainage.	Low available water capacity; rapid intake rate; hummocky; susceptible to soil blowing.	Not suitable	Erodibility; droughty; low fertility.	Moderate: seepage may contaminate underground water supply.	Severe: rapid permeability of the soil will not allow a lagoon to function.
Moderate seepage; in places dugouts are feasible.	Good stability; good workability; low compressibility; water table at a depth of 2 to 6 feet; erodibility of slopes by wind and water.	Good internal drainage; water table at a depth of 2 to 6 feet.	Moderate available water capacity; adequate drainage may be necessary.	Erodibility of diversion slopes; water table at a depth of 2 to 6 feet; in places cuts expose sand of low fertility.	Erodibility; water table at a depth of 2 to 6 feet.	Severe: water table at a depth of 2 to 6 feet.	Severe: moderately rapid permeability; water table at a depth of 2 to 6 feet.

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

Suitability of soils for irrigation is affected by factors, such as available water capacity, permeability, water-intake rate, steepness of slope, and possible limiting depths of leveling cuts.[7]

Use of the soils for terraces, diversions, and grassed waterways is described according to possible erosion hazard from wind and water action, difficulty of establishing vegetation, and according to soil fertility. Maintenance costs of terraces and diversions are greater where siltation occurs from higher elevations. Depth to erodible sands limits the depth of cuts for diversion and terrace alinement. Rough topography and steep slopes are factors in terrace and diversion alinement.

Sewage disposal filter fields are subsurface systems of tile or perforated pipe that distributes effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Use of soils for sewage disposal is described in table 7, including values for soils classification, permeability, and available water capacity. For filter fields, soil limitations are *slight*, *moderate*, or *severe*. *Slight* includes good infiltration without contaminating the underground water; *moderate* includes a finer grained soil with a lower intake rate; *severe* includes a high water table or an impervious soil.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic-matter content, slope, possibility of flooding, and if the floor needs to be leveled, depth to sand or sand and gravel becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the ease of excavation and compaction of the embankment material.

The probability of a soil requiring sealing with bentonite or sodium carbonate or lining with a commercial plastic or rubber liner is indicated. For some soils, proper compaction of earth in the bottom and sides of the lagoon will provide the desired liner. A lagoon constructed in sandy material with a high water table (*severe*) would be the least desirable sewage disposal facility. A sewage filter field or disposal lagoon needs to be located so as not to contaminate wells that furnish domestic water supply or stockwater. Other factors, such as steepness of slope and the possibility of flooding, need to be considered in sewage treatment design.

[7] Further information on soil use for irrigation is in the publication "Irrigation Guide for Nebraska." 1971.

Formation and Classification of the Soils

This section tells how the factors of soil formation have affected the soils in Polk County. It also explains the system of soil classification currently used and classifies each soil series according to that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by natural forces. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly the plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent matrial into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

The soils in Polk County formed in three kinds of parent material—loess, alluvium, and eolian sand. They are of Pleistocene age or younger (*3*).

Loess is the most extensive parent material in the county. It is a light-gray or very pale brown, silty, windblown material that mantles all of the upland and a part of the Platte and Blue River Valleys. In the upland, this loess ranges in thickness from 25 to 45 feet. In the Platte River Valley, it is 3 to 25 feet thick (*4*).

Loess in the Platte River Valley and on upland breaks to the valley is the youngest loess in the county. The loess on the breaks to the Platte River is the thickest. The loess in the Platte River Valley is slightly coarser than that in the uplands.

Hastings, Holder, Cozad, and Fillmore soils formed in loess. Horizons formed over varying periods of time after the loess was deposited. They have a friable, silty, dark-colored surface layer and a subsoil of variable thickness and texture. In small areas on breaks to the Platte River Valley, the loess is reddish brown.

Most of the soil material in the Platte River bottom land was deposited on the flood plains and stream terraces by water.

Texture of alluvial material ranges from coarse to moderately fine. Thickness of the material ranges from 6 inches to 3 feet or more. Soils of the Alda, Darr, Lamo, Leshara, Platte, and Wann series are examples of soils that formed in alluvium.

The alluvium on bottom land adjacent to the Big Blue River and its tributaries is material recently washed from uplands. These deposits are not so variable in texture as alluvium in the Platte River Valley. They are darker colored and more silty. Hobbs and Hord soils and Silty alluvial land formed in this material.

Stream terraces in the Platte River Valley are covered with alluvium that has been in place longer than the alluvium on bottom lands. Hall, Hord, Meadin, O'Neill, and Blendon soils formed on stream terraces. They range in texture from coarse to moderately fine and in depth from 10 inches to more than 40 inches.

Eolian sand in Polk County is alluvium that was reworked by wind. The gently rolling or hummocky Thurman and Blendon soils formed in this material. Eolian sand is on stream terraces of the Platte River Valley near the eastern edge of the county.

Climate

The climate of Polk County is midcontinental. It is characterized by cool springs and abundant rainfall, warm to hot summers, a mild autumn season and varying amounts of rainfall, and cold winters and some snow. Climate is uniform within the county and consequently does not account for significant differences among the soils. Extremes in temperature are below 0° F. in winter and above 100° F. in summer. Average annual precipitation is 26 inches. Average annual temperature is 51° F. In the past, however, climate affected the kinds and amounts of plant and animal life, which is one of the factors in soil formation.

Weathering and reworking of parent material are affected by rainfall, temperature, humidity, and wind. Rainwater shifts, reworks, and deposits soil material many times over long periods of time. Leaching and the downward movement of water in the soil profile are contributing factors in soil formation.

Temperature influences the disintegration and loosening of soil material through freezing and thawing actions. Wetting and drying are also important factors. Speed of chemical action in the weathering process is important. Production and decomposition of organic matter are also influenced by temperature.

The parent material for most soils in Polk County was deposited by wind. Wind also affects evaporation of water and causes damage to plants and the drifting of snow.

Plant and animal life

The native vegetation in Polk County was mainly tall, mid, and short grasses. Narrow bands of trees grew along the streams. Aquatic plants were abundant in the low, wet areas near the Platte River and in the basins of the nearly level uplands. Plants supplied an abundance of organic matter that affected the physical and chemical properties of the soil. These conditions resulted in the formation of the friable, dark, and fertile surface layer. All the soils in Polk County formed under native grasses.

The fibrous roots of the native grasses penetrated the soil, bringing up plant nutrients and moisture for growth. Roots made the soil more porous. The dead roots supplied organic matter to be decomposed and used again by other plants. When the tops of the plants died, organic matter was deposited on the surface and was eventually worked into the surface layer of the soil.

Animal life in the soil transforms organic matter to humus, transforms nitrogen from the air to a form usable by plants, and mixes and moves the soil from place to place. Soil micro-organisms, such as bacteria, fungi, or worms, all help to change organic matter to a form which is used for food for themselves and plants. Earthworms digest organic matter and mix it with soil particles. Burrowing animals and earthworms mix soil materials and provide openings for air and water to enter and move through the soil.

The activities of man, particularly in altering drainage conditions, maintaining fertility, and changing the kinds of vegetation, will have an important effect upon both the rate and direction of soil formation in the future.

Relief and drainage

Polk County has a wide range of relief and a wide range of natural drainage conditions.

Relief, or lay of the land, is one of the major factors affecting runoff, drainage, and water erosion. Steep slopes similar to those on breaks to the Platte River Valley have very rapid runoff. The rainwater runs off rather than soaks into the soil. Consequently, the steeper soils have less development than those on flatter slopes. Steeper soils have a thinner solum and a lighter colored surface layer than soils that have milder slopes and similar parent material. Less moisture is available for plant growth and microbiological activity in the steeper soils, and the soil horizons are indistinct and thin. Lime is not leached deeply in steep soils, such as Coly silt loam.

Generally, nearly level soils have a thick surface layer and subsoil. Much of the rainwater soaks into these soils, increasing plant growth, biological activity, and soil development. Level soils have a thicker, finer textured subsoil than those on steep slopes. Butler and Fillmore soils are nearly level soils.

Soils in depressions are poorly drained and are characterized by a clayey subsoil that shows evidence of strong soil development. Fillmore and Butler soils, for example, formed in upland depressions.

Soils in the Platte River bottom land, at the lowest elevations, have a high water table. These soils are poorly drained or somewhat poorly drained. Decay of organic matter is slower in these than in well-drained soils. Capillary action carries salts to or near the surface. When the water evaporates, the salts remain, making the soils saline or alkaline. Mottling is a common feature in poorly drained soils. Runoff is slow. Alda, Leshara, Platte, and Wann soils are somewhat poorly drained soils on bottom land.

Time

Time is required for all soil formation. The amount of time required depends on the kind of parent material, the effects of the other soil-forming factors involved, and the characteristics of the soil that forms.

The youngest soils in Polk County formed in recently deposited alluvium. They have little or no horizon development because of the short time they have been in place. Hobbs soils and Sandy alluvial land are examples of young soils. Soils that developed in eolian sand and in the youngest loess on uplands are intermediate in age. They have horizons in the beginning stages of development. Thurman, Coly, and Cozad soils are in this category.

The oldest soils of the county are on uplands. They have been in place long enough to have formed genetic horizons that are fairly thick. The texture of the subsoil is finer than that of the parent material. Hastings and Fillmore are examples of these soils.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*7*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*6*) and was adopted in 1965 (*9*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of each soil series of Polk County by family, subgroup, and order, according to the current system, as of May, 1972.

Following are brief descriptions of each of the categories in the current system.

ORDER.—Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions are the Entisols and Histosols, which occur in many different kinds of climate. The two soil orders in Polk County are Entisols and Mollisols.

Entisols are light-colored soils that do not have natural genetic horizons or that have only very weakly expressed beginnings of such horizons. These soils do not have traits that reflect soil mixing caused by shrinking and swelling.

Mollisols formed under grass and have a thick, dark-colored surface horizon containing colloids dominated by bivalent cations. In these soils the soil material has not been mixed by shrinking and swelling.

TABLE 8.—*Soils classified according to the current system of classification*

Series	Family	Subgroup	Order
Alda	Coarse-loamy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.
Blendon	Coarse-loamy, mixed, mesic	Pachic Haplustolls	Mollisols.
Butler	Fine, montmorillonitic, mesic	Abruptic Argiaquolls	Mollisols.
Cass	Coarse-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Coly	Fine-silty, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Cozad [1]	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols
Darr	Coarse-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Fillmore	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hastings [2]	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Hobbs	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Holder	Fine-silty, mixed, mesic	Udic Argiustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Pachic Haplustolls	Mollisols.
Inavale	Mixed, mesic	Typic Ustipsamments	Entisols.
Lamo	Fine-silty, mixed (calcareous), mesic	Cumulic Haplaquolls	Mollisols.
Leshara	Fine-silty, mixed, mesic	Typic Haplaquolls	Mollisols.
Meadin	Sandy-skeletal, mixed, mesic	Udorthentic Haplustolls	Mollisols.
O'Neill	Coarse-loamy, mixed, mesic	Typic Haplustolls	Mollisols.
Ortello	Coarse-loamy, mixed, mesic	Udic Haplustolls	Mollisols.
Platte	Sandy, mixed, mesic	Mollic Fluvaquents	Entisols.
Thurman	Sandy, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Wann	Coarse-loamy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.

[1] The Cozad soils in mapping units CosB3 and CosC3 are taxadjuncts to the Cozad series because they have a lighter colored surface layer than is defined in the range for the series.

[2] The Hastings soils in mapping units HnB3 and HnC3 are taxadjuncts to the Hastings series because they have a thinner, lighter colored surface layer than is defined in the range for the series.

SUBORDER.—Each order has been divided 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.

GREAT GROUP.—Suborders are divided into great groups on 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 the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 8 because it is the last word in the name of the subgroup.

SUBGROUP.—Great groups are divided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups 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.

FAMILY.—Families are established 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, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

Mechanical and Chemical Analysis

Much data on mechanical and chemical properties of soils can be obtained by analysis of the soils in a laboratory. This information is useful to soil scientists in classifying soils and in developing concepts of soil genesis. It is also helpful in estimating available water capacity, soil blowing, fertility, tilth, and other practical aspects of soil management. Data on reaction, electrical conductivity, and percentage of exchangeable sodium are helpful in evaluating the possibility of reclaiming and managing saline-alkaline areas.

Useful data on soil series that are in Polk County, but which were sampled in nearby counties, are recorded in Soil Survey Investigations Report Number 5 (*11*). In this group are the Cass, Hall, Hastings, Hord, Leshara, Thurman, and Wann series.

General Nature of the County

This section describes the early history of Polk County; physiography, relief, and drainage; climate; farming; underground water; transportation and markets; and recreational facilities.

Early History

Polk County was the home of Indians before the white man came. It is a part of the area called "The Great American Desert" on some of the early maps of the area.

Polk County was formed from Butler County in 1870. The settlers were from Europe or were descendants of European immigrants. The eastern parts of the Platte and Big Blue River Valleys were the first areas to be settled.

Native grasses covered the county when the settlers came to Polk County. Farming was and still is the main enterprise in the county. The first crops grown were corn, spring wheat, and garden vegetables. Farming has progressed steadily in the county. According to the 1910 census, only one farm in the county used commercial fertilizer.

Physiography, Relief, and Drainage

Polk County is divided into two physiographic areas. One is the Platte River Valley in the northern part. The other is the nearly level upland plain, which makes up the southern two-thirds of the county. The Platte River flows in a northeasterly direction and forms the north boundary of Polk County.

Within the Platte River Valley are the bottom land along the river and an alluvial terrace south of the bottom land. Steep upland breaks form the south border of the valley.

The bottom land along the Platte River is the flood plain. It has not been flooded in recent years because of dams built upstream on the Platte River. This bottom land is nearly level and has old channels and small sandy ridges. Surface drainage is to the northeast. Runoff water flows into Clear Creek, a tributary of the Platte River, and thence to the South Channel of the Platte River. The bottom land of the Platte River Valley is less than half a mile wide at the western county line and more than 3 miles wide at the eastern county line. This area is the Platte-Leshara-Alda soil association.

The alluvial terrace south of the bottom land extends from the eastern boundary to the western boundary of the county. It is from 0.5 mile to 3 miles wide. Except for a hummocky area near the eastern boundary of the county, it is mainly nearly level. Surface drainage is northward into Clear Creek and toward the Platte River. This area consists of the Hord and Thurman-Meadin soil associations.

Breaks to the Platte River Valley form the south border of the Platte River Valley. They make up a rough, steep area dissected by many intermittent drainageways. They form a continuous band that stretches from the eastern to the western boundary of the county. The breaks are 0.5 mile to more than 4 miles wide and 125 to 150 feet high from the base to the crest. Surface drainage is northward into Clear Creek and the Platte River. This area is the Coly-Cozad soil association.

South of the breaks to the Platte River Valley is the nearly level, broad, loess-mantled upland. This is the largest physiographic area in the county; it occupies the southern two-thirds of the county. It is drained by the North Branch of the Big Blue River and its tributaries. Except for a few basins or depressions, nearly all of the county has a well established drainage pattern.

The basins receive runoff from the surrounding area. A few are drained by ditches or mechanical means. Hastings, Holder, and Fillmore soils are in this physiographic area.

Soils on the uplands range from nearly level to steep. They are steepest along the sides of intermittent drainageways and streams.

The South Channel of the Platte River was blocked many years ago. It receives no water from the main channel, only runoff from the surrounding areas.

The Platte River is classified as a flowing stream. In some years, however, it is dry during the summer because upstream dams divert water for irrigation, power, and recreation. The Platte River is normally wide and shallow. The channel is the braided type. There are many islands.

Climate [8]

Polk County is in east-central Nebraska near the center of the large land mass of North America. There are no large bodies of water nearby; therefore, the climate is strictly continental in character. Rainfall is moderate; summers are relatively warm, and winters are cold. There are great variations in temperature and rainfall from day to day and from season to season. Most of the moisture that falls in the area is brought in from the Gulf of Mexico on southerly winds. As a rule, over three-fourths of the annual precipitation occurs during the months of April to September, when prevailing winds are from the south. There is very little precipitation during midwinter, when the prevailing winds are from the north. Rapid temperature changes result from the interchange of warm winds from the south and southwest with the cold air from the north and northwest.

Precipitation early in spring is of a slow, steady type and is well distributed. As spring advances, an increasing amount of the precipitation occurs as thundershowers. Heavy rains may be reported in one locality, while an area nearby receives little or no rainfall. Local drought conditions develop when showers become poorly spaced in time or area.

In spring and early in summer, thunderstorms become severe at times and may be accompanied by local downpours, hail, and damaging winds, or by an occasional tornado. An inch of rain falls within a 30-minute period, on the average, once each year, and nearly 2 inches falls in half an hour once in 10 years. Even greater intensities occur for brief periods. For example, about once in 2 years a local downpour falls at the rate of 4 inches per hour, but it lasts only 5 to 10 minutes. The hailstorms that sometimes occur in connection with the downpours are generally local in extent, of short duration, and produce damage in an extremely variable and spotted pattern. Total loss of crops in the center of the hail strips of the more intense storms has been reported.

Table 9 shows that the average monthly rainfall increases from 1.5 inches in March to 4.3 inches in June. From July on, the amount of precipitation received declines gradually as showers become lighter and less frequent. The fall season is characterized by an abundance of sunshine and by mild days and cool nights.

Winter precipitation is generally light, and almost all of it occurs in the form of snow, even though many winters have one or more periods of freezing rain. The snow is often accompanied by strong, northerly winds and a change to colder weather. Average annual snowfall is about 30 inches, but the amount varies considerably from year to year. Frequently the snow melts before the next snowfall arrives. During an average winter, there are only 51 days with snow cover.

The frequency of high and low temperatures is indicated in table 9. For example, the third column shows that in 2 years in 10 the temperature on at least 4 days in July is 101° F. or higher, and the average annual maximum is 104°. Likewise, the fourth column shows that in 2 years in 10 the temperature on at least 4 days in January falls to at least −10°, and the average annual minimum is −16°. The highest temperature ever recorded was 116° in 1936, and the lowest was −30° in 1912.

The probabilities of freezing temperatures after specified dates in the fall are shown in table 10. For example, in half the years, the air temperature falls below 32° F. after April 30 (average date of the last freeze), but in 1 year in 10 a freeze occurs after May 16. In fall a freeze occurs before September 25 only once in 10 years.

Annual free-water evaporation from shallow lakes averages about 44 inches, and about 76 percent of that amount occurs in the 6-month period of May through October.

Farming

The first settlers in Polk County grew corn, spring wheat, and garden vegetables for food. Cattle were raised on the abundant supply of grass that was available. Compared with modern agricultural technology, early farming methods were very crude. Farmers had little knowledge of climate, seed selection, seedbed preparation, fertilization, and crop rotation systems. Consequently, yields were low.

As more modern methods and knowledge came into use, yields increased, different kinds of crops were grown, and farming methods improved in all categories. Alfalfa, winter wheat, soybeans, and sorghum were introduced. Hogs were raised for market to utilize the increase in crop production. Milk cows and chickens were raised for food and cash income. Irrigation, new seed varieties, fertilizers, insecticides, weedicides, modern farm machinery, and the best of farming methods are now used to obtain maximum production. Improved strains of beef cattle are raised for market or are fattened and then marketed. Farms in Polk County are mainly the livestock-grain and cash-grain types.

Irrigation has become an important part of the economy since the late 1950's. As of January 1, 1970, there were 946 irrigation wells registered in the county. These wells were used to irrigate 86,700 acres of crops in 1969. Almost 20,000 tons of commercial fertilizer were applied to 158,000 acres of crops in 1968. About 56,600 acres of irrigated corn and 9,800 acres of dryfarmed corn was harvested for grain. The average yield was 106 bushels per acre under irrigation and 54 bushels per acre under

[8] Prepared by RICHARD E. MYERS, Nebraska State climatologist, National Weather Service.

TABLE 9.—*Temperature and precipitation data*

[All data from Osceola, Nebr.]

Month	Temperature				Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Two years in 10 will have at least 4 days with—		Average total [1]	One year in 10 will have—		Days with 1 inch or more snow cover [1]	Average depth of snow on days with snow cover [1]
			Maximum temperature equal to or higher than [2]—	Minimum temperature equal to or lower than [2]—		Equal to or less than [3]—	Equal to or more than [3]—		
					In.	*In.*	*In.*	*No.*	*In.*
January	33	11	55	−10	0.7	(4)	1.7	16	5
February	38	16	60	−5	1.1	.1	2.0	13	5
March	47	25	71	6	1.5	.3	2.5	8	6
April	63	38	82	25	2.5	.7	4.1	1	3
May	75	49	88	36	3.9	1.5	6.7	(5)	1
June	84	59	97	48	4.3	1.7	6.8	------	------
July	90	64	101	55	3.2	.9	6.5	------	------
August	88	63	99	53	2.8	1.2	5.9	------	------
September	79	53	95	38	2.6	.8	6.6	------	------
October	69	42	83	26	1.1	.1	3.5	------	------
November	50	27	69	12	.8	(4)	2.3	3	3
December	38	17	57	−4	.7	(4)	1.5	10	4
Year	63	39	[6] 104	[7] −16	25.3	17.8	35.6	51	5

[1] Data based on 1937–66 period.
[2] Data based on the 1898–1963 period.
[3] Data based on the 1884–1966 period.
[4] Trace.
[5] Less than half a day.
[6] Average annual maximum.
[7] Average annual minimum.

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

[All data from Osceola, Nebr.]

Probability	Dates for given probability and temperature of—				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	April 6	April 14	April 22	May 6	May 16
2 years in 10 later than	April 1	April 9	April 16	May 1	May 10
5 years in 10 later than	March 21	March 30	April 6	April 20	April 30
Fall:					
1 year in 10 earlier than	October 28	October 22	October 15	October 4	September 25
2 years in 10 earlier than	November 2	October 27	October 21	October 9	September 30
5 years in 10 earlier than	November 13	Novmeber 5	October 30	October 19	October 10

dryland farming. About 8,000 acres of irrigated sorghum and 34,130 acres of dryfarmed sorghum was harvested for grain in Polk County. The average yield under irrigaton was 92 bushels per acre, and 61 bushels per acre under dryland farming. Wheat was harvested on nearly 31,000 acres. The yield was about 37 bushels per acre. Alfalfa was grown on 9,740 acres and averaged 49 tons per acre (*5*).

Irrigation wells in Polk County are about 117 feet deep. The static water level is at a depth of 97 feet. About 1,000 gallons per minute can be pumped from the average irrigation well. The average number of acres irrigated per well is more than 100.

The number of farms in the county is decreasing slightly. In 1969 there were 900 farms in the county (*5*).

There is some commercial truck gardening on bottom land in the Platte River Valley. The potential for expansion of these crops is good.

Underground Water

Polk County has an abundant supply of underground water. There are, however, a few small areas where water is either difficult to find or can not be obtained. The quality of the water is good. Water is closest to the surface in the bottom land of the Platte River Valley. Here it is within a depth of 15 feet. In the upland areas, it is at a depth of about 100 feet.

In nearly all parts of the county, wells for domestic use are easily obtained by drilling. Good irrigation wells can be obtained by drilling to greater depths than required for domestic wells.

Transportation and Markets

Polk County has good market and transportation facilities. Graded and gravelled, or improved dirt roads are on most section lines. U.S. Highway No. 81 traverses the county from north to south. State Highway No. 92 is a single, hard-surfaced, east to west highway. State Highway No. 39 extends from State Highway No. 92 northward to the town of Silver Creek. State Highway No. 66 is in the southwestern part of the county and extends from U.S. Highway No. 81 west to the town of Polk.

Rural mail routes reach all parts of the county, and mail deliveries are daily except Sundays and holidays. Livestock and crops are shipped to markets mainly by trucks. These markets are at Omaha, 90 miles east of the county; at York, 20 miles to the south; and at Columbus, 30 miles to the northeast.

Recreational Facilities

Facilities are available in the county for hunting, fishing, boating, and picnicking. The most intensive recreational development is at Duncan Lake, where some summer homes have been built and a gravel pit has been developed for fishing, water skiing, and swimming. Hunting of waterfowl is common on the Platte River, and upland game birds are hunted throughout the county. Deer are to be found along the major streams. Streams and farm ponds are stocked with fish.

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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. 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 soil 60 inches deep, or to a limiting layer are:

Inches	
0 to 3	Very low
3 to 6	Low
6 to 9	Moderate
More than 9	High

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Catsteps. Narrow steps on moderately steep and steep hillsides, caused by slumping or soil slippage.

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.

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.

Depth, soil. The total thickness of weathered soil material overlying mixed sand and gravel or bedrock. In this survey, the classes of soil depth used are:

Inches	
0 to 10	Very shallow
10 to 20	Shallow
20 to 40	Moderately deep
More than 40	Deep

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.

Dune. A mound or ridge of loose sand piled up by the wind.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

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.

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.

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 at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Lime. Chemically, lime is calcium oxide (CaO), but its meaning has been extended to include all limestone-derived materials applied to neutralize acid soils. Agricultural lime can be obtained as ground limestone, hydrated lime, or burned lime, with or without magnesium minerals. Basic slag, oystershells, and marl also contain calcium.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Permeability. The quality that enables the soil to transmit air and water. In this survey, terms used to describe permeability apply to that part of the soil below the Ap or equivalent layer, and above a depth of 60 inches, or to bedrock, if it occurs within a depth of 60 inches. Where there is a change of two or more permeability classes within a short vertical distance, the classes and depths are stated. Classes of soil permeability are:

Inches per hour	
Less than 0.063	Very slow
0.063 to 0.20	Slow
0.20 to 0.63	Moderately slow
0.63 to 2.00	Moderate
2.00 to 6.30	Moderately rapid
6.30 to 20.00	Rapid
20.00 and higher	Very rapid

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.2 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff, surface. The water that flows off the land surface without sinking in.

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. The salts, exchangeable sodium, and alkaline reaction occur in the soil in such location that growth of most crop plants is less than normal.

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.

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.

Slope. The degree of deviation of a surface from the horizontal, usually expressed in percent or degrees. In this survey, the following slope classes are used:

Percent	
0 to 1	Nearly level
1 to 3	Very gently sloping
3 to 7	Gently sloping or gently rolling
7 to 11	Moderately sloping
11 to 31	Moderately steep or steep
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 parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *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.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Underlying material. In this survey, the weathered soil material immediately beneath the solum.

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