SOIL SURVEY OF

Franklin County, Nebraska

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

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1966–73. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. 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 Lower Republican Natural Resources District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms 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 Franklin 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 shows the windbreak suitability group and range site in which the soil has been placed.

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

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

Foresters and others can refer to the section "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 "Wildlife and Recreation."

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

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreational areas in the section "Engineering Uses of the Soils."

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

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

Newcomers in Franklin County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They will also be interested in the information about the county given in the section "General Nature of the County."

Cover: A farmstead in central Franklin County showing field windbreaks in an area of Holdrege soils. (Courtesy of Richard Hufnagle, photographer.)

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SOIL SURVEY OF FRANKLIN COUNTY, NEBRASKA

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

FRANKLIN COUNTY is in the south-central part of Nebraska (fig. 1). It is about 24 miles on each side. The total area is 369,920 acres. The county seat and largest town is Franklin. Franklin County is in the Great Plains physiographic province.

The first permanent settlements in the county were established in 1870, and the county was organized in 1871. By 1880 the population was about 5,000. The population of the county continued to grow until about 1920, and then it began to decline. In 1900 the population was 9,455, in 1920 it was 10,067, and in 1970 it was 4,566. Most of the people in the county live in towns and villages and depend on farming or farm-related industries for their livelihood.

Most of the soils in Franklin County formed in silty loess on uplands. About 60 percent of the soils are well drained, about 14 percent are somewhat excessively drained, and about 7 percent are excessively drained. The remaining 19 percent are moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained; some areas of these soils are frequently flooded.

A large area in the northwestern and north-central parts of the county is a broad, nearly flat upland plain. The area is interspersed with small depressions and a few intermittent lakes. This area of silty soils makes up about 33 percent of the county.

The largest physiographic area in the county is the silty uplands north of the Republican River Valley. This area occupies about 41 percent of the county. It consists mainly of broad divides alternating with moderately entrenched drainageways, but it has a few hummocky sandhills that border Thompson and Center Creeks. Slopes are very gently sloping to steep. Surface water flows mainly south to the Republican River.

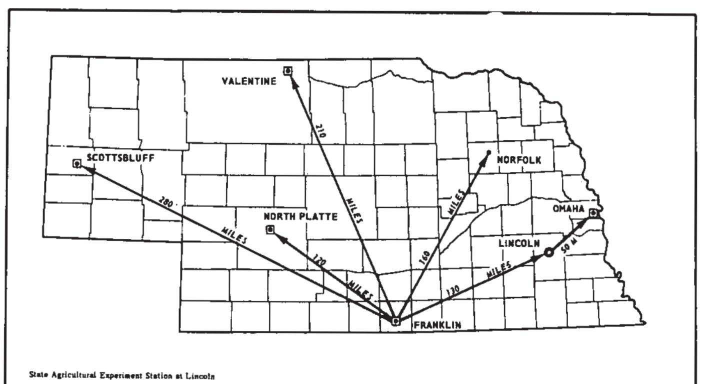

Figure 1.—**Location of Franklin County in Nebraska.**

The Republican River Valley crosses the southern part of the county and is about 2 miles wide. It consists of bottom land, well defined stream terraces, and a few adjacent foot slopes. The valley makes up about 9 percent of the county.

The upland area south of the Republican River Valley consists of divides alternating with deeply entrenched drainageways. The loamy and silty soils are very gently sloping to steep. A few soils formed in material weathered from sandstone and chalkrock. This area makes up about 17 percent of the county.

About 54 percent of the total acreage in the county is cultivated cropland or is fallow, 43 percent is grassland, and 3 percent is woodland and rivers. About 59,000 acres of the cropland is irrigated with water from deep wells from the Bostwick Irrigation District or with water siphoned from the Republican River, Thompson Creek, or Turkey Creek. Corn, grain sorghum, alfalfa, and wheat are the principal crops grown in the county. Cattle and hogs are the main livestock raised. Cash grain crops are sold to the local grain elevators or are shipped to the larger markets by rail and truck. Livestock is marketed locally at Franklin or shipped to larger terminal markets. Small quantities of fruits, vegetables, and hay are grown. Honey is produced commercially in Franklin.

Several sand and gravel pits north of the Republican River Valley furnish sand and gravel for roads and other construction projects.

The climate of Franklin County is subhumid, and average annual precipitation is 23.4 inches. The length of the average growing season is 153 days.

An earlier soil survey of Franklin County was published by the United States Department of Agriculture in 1926 (*4*).[1] The present survey was made to provide up-to-date information on the soils and because advances have been made in soil interpretations, engineering, and soil classification since the earlier maps were published. The new maps are also larger than the old ones and show the soils in greater detail.

[1] Italic numbers in parentheses refer to Literature Cited, p. 92.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Franklin 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 nature of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

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

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is commonly named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Holdrege and Inavale 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 layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Holdrege silt loam, 1 to 3 percent slopes, is one of several phases within the Holdrege series.

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

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

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Franklin County: soil complexes and undifferentiated soil groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Nuckolls-Hobbs complex, 9 to 30 percent slopes, is an example.

An undifferentiated soil group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils joined by "and." Nuckolls and Holdrege silt loams, 6 to 9 percent slopes, is an undifferentiated soil group in Franklin County.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Broken alluvial land is a land type in this survey.

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

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

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their study and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area.

A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in other associations, but in different patterns.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to locate large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide for broad planning on a watershed, a wooded tract, or a wildlife area or for broad planning of recreational facilities, community developments, and such engineering works as transportation corridors. It is not a suitable map for detailed planning for management of a farm or field or for selecting the exact location of a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Soil association names and delineations on the general soil map do not fully agree with those of the general soil maps in adjacent counties published at a different date. Differences on the maps are the result of improvements in the classification or refinements in soil series concepts. In addition, more precise maps are needed because the uses of the general soil map have expanded in recent years. The more modern maps meet this need.

The soil associations in Franklin County are described on the pages that follow.

1. *Holdrege association*

Deep, nearly level and very gently sloping, silty soils on loess uplands

This association is on a broad upland plain (fig. 2). It is characterized by numerous depressions and a few intermittent lakes.

This association makes up about 33 percent of the county. It is about 75 percent Holdrege soils and 25 percent minor soils and intermittent lakes.

Holdrege soils are on the highest elevations of the landscape. They are deep, well drained soils. The surface layer is friable silt loam. The subsoil is silty clay loam in the upper and middle parts and silt loam in the lower part. The underlying material is silt loam.

Minor in this association are the Kenesaw, Hall, Detroit, Fillmore, Butler, Hastings, and Scott soils. Kenesaw soils are slightly hummocky and are on the higher elevations. Hall, Detroit, and Hastings soils are on the lower part of the plains in lower positions than Holdrege soils. Butler soils are in shallow depressions. Fillmore and Scott soils are in deeper, better defined

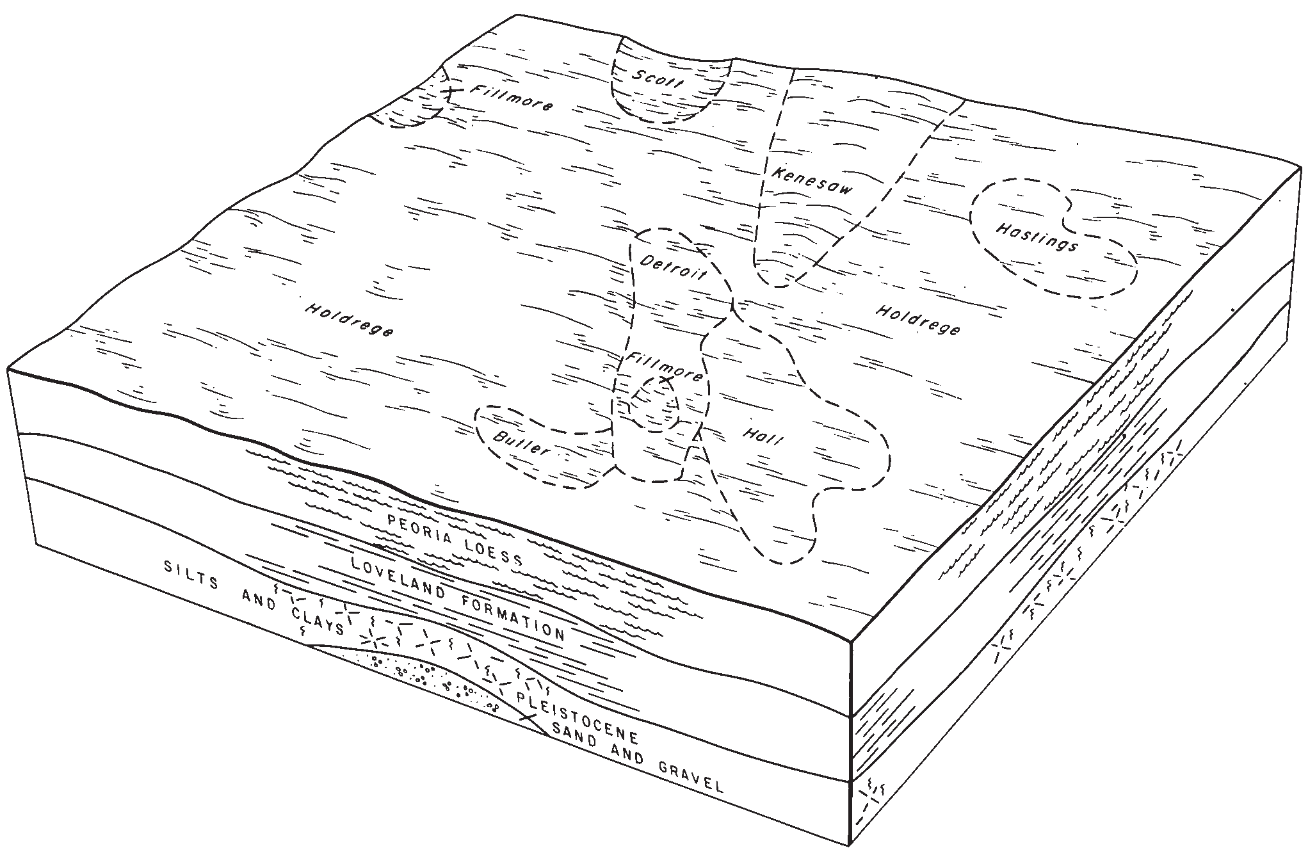

Figure 2.—**Typical pattern of soils and underlying material in the Holdrege association.**

depressions than Butler soils. Intermittent lakes are in the lowest areas of the landscape and receive runoff water from surrounding soils.

Most of the acreage in this association is cultivated. A few, wet, undrained areas are used for permanent range or as habitat for wildlife. Much of the acreage in crops is irrigated with water from deep wells. The soils are well suited to the production of grain and forage crops. The principal crops are corn, grain sorghum, wheat, and alfalfa. The main farm enterprises are growing cash grain crops, dairying, and fattening livestock in farmstead feedlots.

The main hazards and concerns in management are lack of adequate rainfall for dryfarmed crops, maintaining fertility, and soil blowing. A few areas, principally the depressions, need improvement in surface drainage for good crop growth.

The average size of farms in this association is about 560 acres. Gravel or improved dirt roads are on most section lines, but roads are not on all section lines. Most highways are paved.

Grain crops are marketed within the county. Feeder and stocker cattle and hogs are sold at local auctions. Fattened cattle are trucked to terminal markets, mainly in Omaha. Hildreth and Upland are towns in this association.

2. *Nuckolls-Holdrege-Uly association*

Deep, very gently sloping to steep, silty soils on divides and side slopes of drainageways on loess uplands

This association is on divides and side slopes of drainageways (fig. 3). The divides and side slopes are in an alternating pattern on the landscape. Areas on the divides are very gently sloping to strongly sloping,

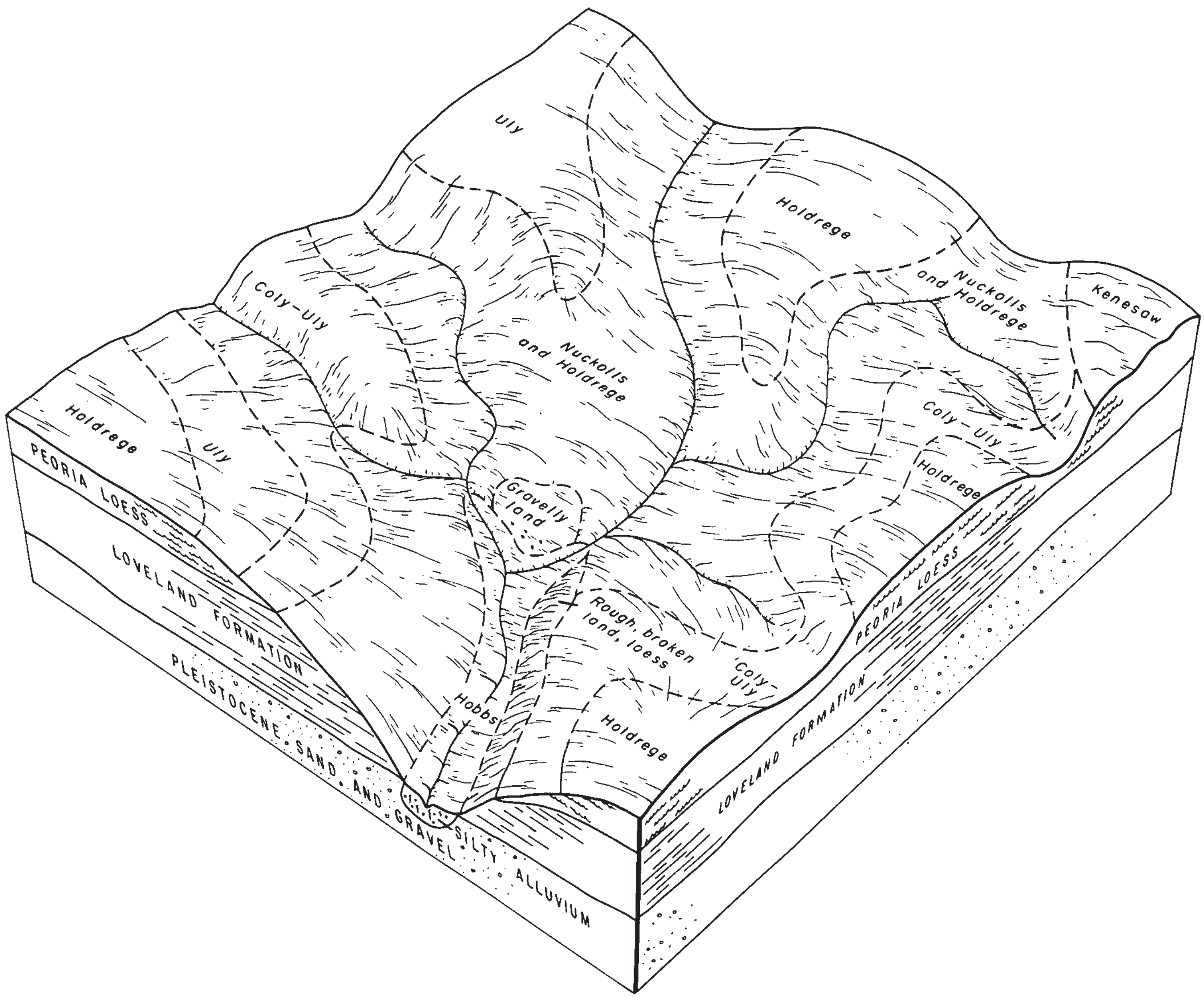

Figure 3.—Typical pattern of soils and underlying material in the Nuckolls-Holdrege-Uly association.

and areas on the side slopes are moderately steep and steep. The drainageways are intermittent and are spring-fed tributaries of the Republican and Little Blue Rivers. Many creeks traverse this association.

This association makes up about 36 percent of the county. It is about 39 percent Nuckolls soils, 20 percent Holdrege soils, and 17 percent Uly soils. The remaining 24 percent is minor soils and land types.

Nuckolls soils are on the lower parts of divides and on side slopes of drainageways. They are deep, gently sloping to steep, well drained or somewhat excessively drained soils. The surface layer is moderately thick, friable silt loam, and the subsoil is silt loam. The underlying material is at a depth of about 29 inches. It is silt loam.

Holdrege soils are on the upper parts of the divides. These soils are very gently sloping to strongly sloping and are well drained. The surface layer is friable silt loam. The subsoil is silty clay loam in the upper and middle parts and silt loam in the lower part. The underlying material is at a depth of 34 inches. It is silt loam.

Uly soils are on the lower part of the divides in lower positions than the Holdrege soils. These soils are gently sloping to steep. They are well drained. They have a moderately thick surface layer of silt loam and a subsoil of silt loam. The underlying material is at a depth of about 26 inches. It is silt loam.

Minor in this association are the Coly, Hobbs, and Kenesaw soils; Broken alluvial land; Rough broken land, loess; Sandy alluvial land; and Gravelly land complex. Coly soils are in areas that border the intermittent drainageways, Hobbs soils are on the narrow bottoms of the small drainageways, and Kenesaw soils are on the upper part of some divides. Broken alluvial land is on the bottoms of larger drainageways where flooding is frequent or where there are deep, meandering channels. Rough broken land, loess, is on very steep canyon walls where "catsteps" are common. Sandy alluvial land is on the flood plains of streams and is flooded after heavy rains. Gravelly land complex is on the convex hillsides adjacent to some drainageways, where mixed sand and gravel make up about 50 to 75 percent of the surface.

Farm enterprises in this association are diversified but consist mainly of cash grain-livestock operations. The soils on the divides are used mainly for dryfarmed crops, chiefly wheat and grain sorghum. The steep soils adjacent to drainageways are mainly in permanent grass that is used for grazing livestock. A few areas of the very gently sloping soils are irrigated from deep wells and are used for cultivated crops. A few farmers fatten beef cattle in farmstead feedlots.

Water erosion, soil blowing, and lack of adequate rainfall are the main hazards on the dryfarmed soils. Maintaining high fertility and preventing erosion are the main concerns in managing irrigated land. Proper stocking and controlling water erosion are concerns in management on grazing land.

The average size of farms in this association is about 800 acres. Most section lines have gravel or improved dirt roads, but roads are not on all section lines. Highways are hard surfaced.

Most of the cash grain is sold to elevators in the county. Livestock, mainly feeder cattle and hogs, is sold at local auctions. Fattened cattle are transported to large terminal markets, mainly in Omaha. Bloomington and Campbell are towns located mainly in this association.

3. *Valentine-Hersh-Nuckolls association*

Deep, very gently sloping to very steep, sandy, loamy, and silty soils on uplands

This association is in areas along West Branch Thompson Creek, Center Creek, Sassacus Creek, and Cottonwood Creek (fig. 4). The highest elevations are hummocky or hilly, and sandy and loamy soils are in these positions. In many places side drains have eroded into the landscape and silty material is at the surface.

This association makes up about 5 percent of the county. It is about 28 percent Valentine soils, 25 percent Hersh soils, and 21 percent Nuckolls soils. The remaining 26 percent is minor soils and land types.

Valentine soils are on the hummocky and hilly parts of the landscape. They are steep to very steep and are excessively drained. The surface layer is thin, loamy sand. Beneath this is a transitional layer of fine sand. The underlying material, at a depth of about 9 inches, is fine sand.

Hersh soils are on low hills, ridges, and the hummocky parts of the landscape. They are very gently sloping to strongly sloping and are well drained. They have a surface layer of fine sandy loam and a transitional layer of sandy loam. The underlying material, at a depth of about 16 inches, is sandy loam in the upper part and loamy sand in the lower part.

Nuckolls soils are on the side slopes of intermittent drainageways. They are gently sloping to steep and are well drained or somewhat excessively drained. The surface layer, subsoil, and underlying material are silt loam.

Minor in this association are Sandy alluvial land, Gravelly land complex, and Holdrege soils. Sandy alluvial land is on the alluvial flood plains of narrow stream valleys. These areas are dry during most of the year, but they are flooded after heavy rains. Gravelly land complex is on convex hillsides in much of the area where mixed sand and gravel are at the surface. Holdrege soils are in areas on the silty uplands.

Farm enterprises in this association are mostly cash grain-livestock operations. Small cow-calf operations are common. Most of the acreage is in native grasses and is used for grazing. Many of the less sloping areas are in wheat and grain sorghum. The wheat is sold as cash grain. Much of the grain sorghum is used on farms as livestock feed.

The principal concern in management of range is proper use and controlled grazing. The principal hazards on range are water erosion and soil blowing, and on the cultivated areas they are water erosion, soil blowing, and a lack of adequate rainfall.

The average size of farms in this association is about 960 acres. Roads are very few. The feeder cattle and hogs are marketed at local auctions. Fattened cattle are trucked to larger terminals. Cash grain is sold to local elevators.

4. *Munjor-Inavale-McCook association*

Deep, nearly level and very gently sloping, loamy, sandy, and silty soils on bottom lands

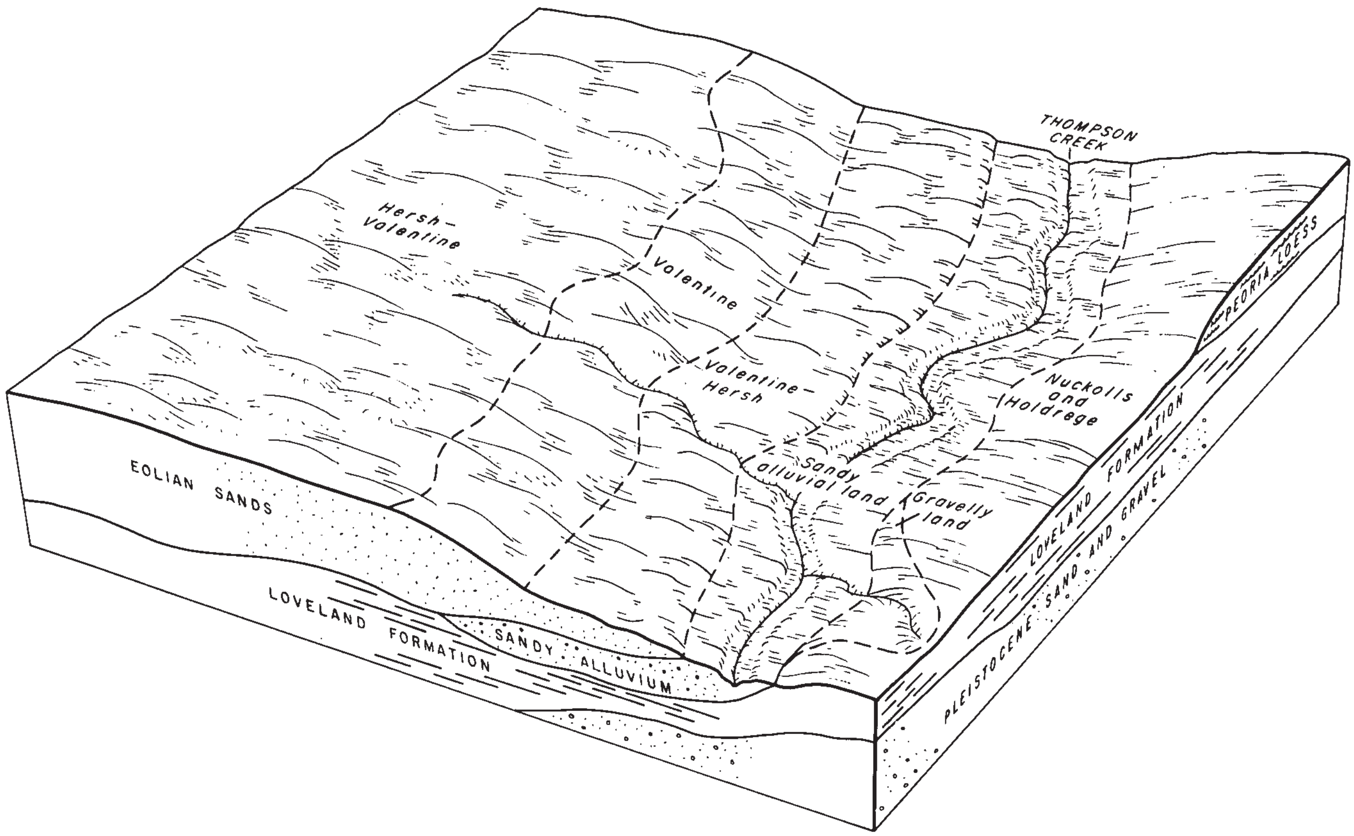

Figure 4.—**Typical pattern of soils and underlying material in the Valentine-Hersh-Nuckolls association.**

This association is on bottom lands on the Republican River and its larger tributaries (fig. 5), principally Thompson Creek.

This association makes up about 6 percent of the county. It is about 27 percent Munjor soils, 14 percent Inavale soils, and 14 percent McCook soils. The remaining 45 percent is minor soils and land types.

Munjor soils are on bottom lands. They are deep, nearly level, and well drained. The surface layer is very friable fine sandy loam or loamy fine sand. The upper part of the underlying material is sandy loam, and the lower part is coarse and medium sand.

Inavale soils are on the highest part of the bottom lands, commonly in areas that have a low hummocky surface. They are deep and excessively drained. The surface layer is very friable loamy sand or fine sandy loam. Beneath this is a transitional layer of loamy sand. The underlying material, at a depth of 24 inches, is sand that is stratified with thin layers of silty and sandy material.

McCook soils are on bottom lands. They are nearly level and well drained. The surface layer is silt loam or fine sandy loam. Beneath this is a transitional layer of lighter colored silt loam. The underlying material is at a depth of 21 inches. It is very fine sandy loam in the upper part and sandy loam in the lower part.

Minor in this association are Wann, Roxbury, Gibbon, and Hobbs soils; Riverwash; Broken alluvial land; and Marsh. Wann and Gibbon soils are on the lower elevations of the valleys. The water table in these soils fluctuates between depths of 2 and 6 feet. Roxbury soils are on alluvial fans and foot slopes. Hobbs soils are on narrow bottoms of small drainageways that terminate in the larger valleys. Riverwash consists of sandbars, sand flats, and small islands within and adjacent to the channels of the Republican River. Broken alluvial land consists of frequently flooded areas of bottom land along small streams. Marsh is in low, concave, very wet areas of the Republican River bottom lands where water is near or on the surface during most of the year.

The main farm enterprises are growing cash grain crops, dairying, and fattening beef cattle and swine in farmstead feedlots. Crops are grown under dryland and irrigated management. Corn, grain sorghum, wheat, and alfalfa are the common crops. Most grain is sold for cash, but a small part is used on the farm as livestock feed. Irrigation water is available from shallow wells and from the Bostwick Irrigation District. A few areas of sandy soils are in native grasses that are used mainly for grazing.

Water erosion, soil blowing, and lack of adequate rainfall are the main hazards on dryfarmed soils. Maintaining fertility is an important concern on irrigated soils. Maintaining proper stocking rates and control-

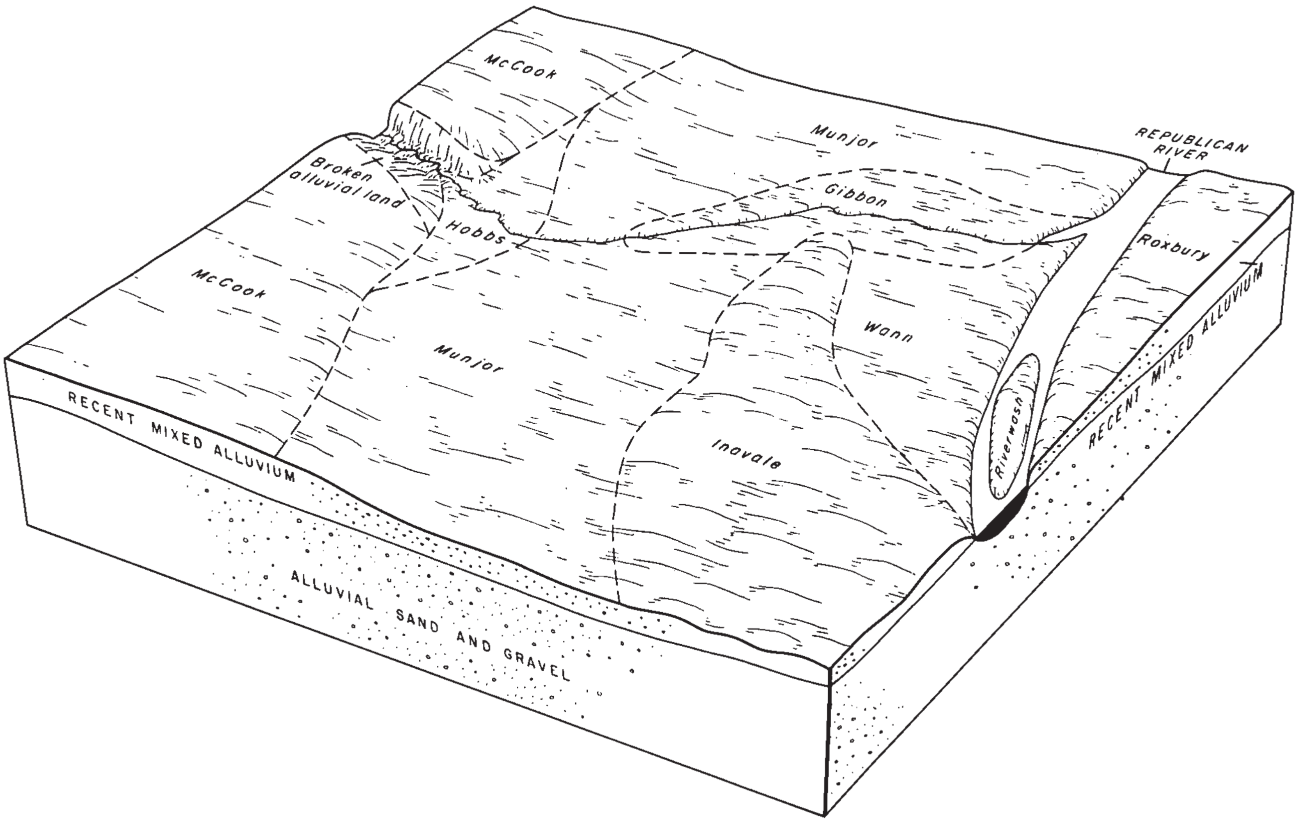

Figure 5.—**Typical pattern of soils and underlying material in the Munjor-Inavale-McCook association.**

ling water erosion are concerns in management on range.

The average size of farms in this association is about 480 acres. A few gravel and improved dirt roads cross this association, but many section lines lack roads. Cash grain crops are marketed at local elevators. The feeder cattle and hogs are generally sold at local auctions, and the fattened cattle are trucked to larger terminal markets. Riverton and Naponee are towns located mainly in this association.

5. *Nuckolls-Holdrege-Campus association*

Deep, very gently sloping to steep, silty soils and moderately deep, steep loamy soils underlain by bedrock; on uplands

This association is in an area south of the Republican River. It is on divides and deeply entrenched drainageways that are in an alternating pattern on the landscape (fig. 6). Areas on the divides are very gently sloping to strongly sloping, and areas in the drainageways are moderately steep and steep. Outcrop of rock is common on the steep side slopes. The creeks in this association are intermittent or spring-fed. They drain in a northerly direction into the Republican River.

This association makes up about 17 percent of the county. It is about 33 percent Nuckolls soils, 17 percent Holdrege soils, and 16 percent Campus soils. The remaining 34 percent is minor soils.

Nuckolls soils are on divides and on side slopes of the intermittent drainageways. They are gently sloping to steep and are well drained or somewhat excessively drained. The surface layer and subsoil are silt loam. The underlying material is at a depth of 29 inches. It is silt loam.

Holdrege soils are on the upper part of the divides. They are deep, very gently sloping to strongly sloping, and well drained. The surface layer is silt loam. The subsoil is silty clay loam in the upper and middle parts and silt loam in the lower part. The underlying material, at a depth of 34 inches, is silt loam.

Campus soils are on the sides of hills that border the intermittent drainageways. They are moderately deep, moderately steep and steep, and well drained. The surface layer and underlying material are loam. Limy sandstone bedrock is at a depth of about 25 inches.

Minor in this association are Coly, Hobbs, Kipson, Canyon, and Uly soils; Broken alluvial land; Rough broken land, loess; and Rough stony land. Coly and Uly soils are on ridgetops and upper side slopes of hills. Kipson soils are on lower side slopes that border intermittent drainageways. Canyon soils are on lower side slopes below Campus soils. Hobbs soils are in

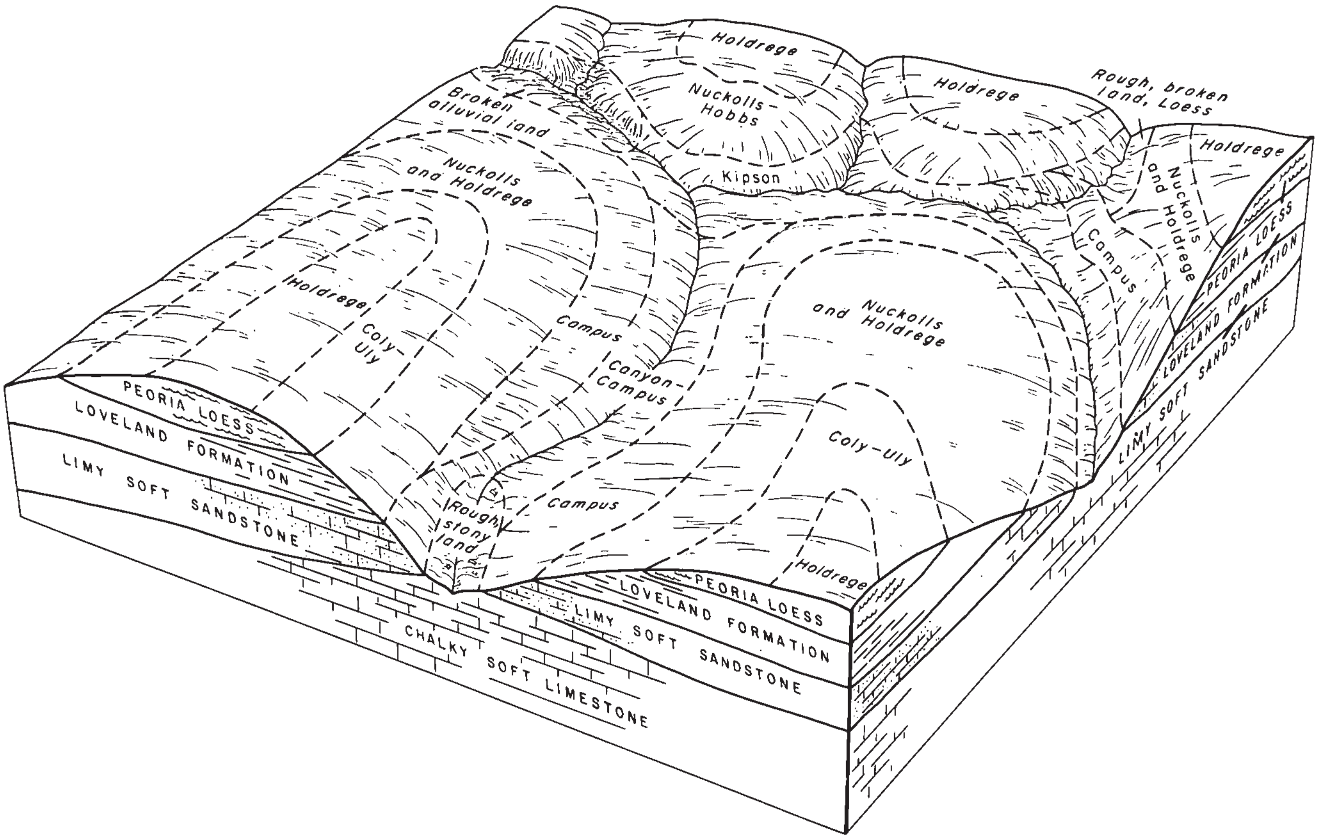

Figure 6.—**Typical pattern of soils and underlying material in the Nuckolls-Holdrege-Campus association.**

intermittent drainageways and on side slopes below Holdrege soils. Broken alluvial land is on frequently flooded bottom land near creeks. Rough broken land, loess, is on the sides of very steep canyons. Rough stony land is in convex areas where consolidated sandstone or chalky limestone is exposed at the surface over most of the area.

Farm enterprises in this association are a combination of cash grain and livestock operation. Soils on the divides are used mainly for cultivated dryfarmed crops. Wheat and grain sorghum are the principal crops. Most areas that are moderately steep and steep are in native grasses and are mainly used for grazing beef cattle. Small cow-calf herds are common.

Water erosion, soil blowing, and lack of adequate rainfall are the main hazards on dryfarmed soils. Proper stocking, deferred grazing, and water erosion are concerns in management of range.

The average size of farms in this association is about 1,260 acres. Gravel or improved dirt roads are on a few section lines. One paved highway crosses the association. Cash grain crops are marketed locally. Feeder cattle and hogs are sold at local auctions, and fattened cattle are trucked to larger terminal markets.

6. *Hord association*

Deep, nearly level and very gently sloping, silty soils on stream terraces

This association is on stream terraces of the Republican River and Turkey Creek.

This association makes up about 3 percent of the county. It is about 89 percent Hord soils and about 11 percent minor soils and land types.

Hord soils are on stream terraces that are 15 to 35 feet above the adjacent bottom lands. These soils are well drained. The surface layer is moderately thick. The surface layer and subsoil are silt loam. The underlying material, at a depth of 41 inches, is silt loam.

Minor in this association are Hall, Hobbs, and Wann soils; Broken alluvial land; and Sandy alluvial land. Hall soils have a slightly concave surface. Hobbs soils are on the narrow bottoms of drainageways. They are occasionally flooded. Wann soils are in low areas below Hord soils where the water table is at a depth between 2 and 6 feet. Broken alluvial land is on bottom lands along the small streams that cross this association. It is frequently flooded. Sandy alluvial land is on the sandy flood plains. It is flooded after heavy rains.

The main farm enterprises are producing cash grain crops, dairying, and feeding hogs and cattle in farmstead feedlots. Crops are grown under dryland and irrigated management. Wheat is the main dryfarmed crop. Corn, grain sorghum, and alfalfa are the principal irrigated crops. Irrigation water is from the Bostwick Irrigation District. The soils are well suited to growing dryfarmed and irrigated crops.

Soil blowing and lack of adequate rainfall are the principal hazards on the cultivated soils. Maintaining fertility is an important concern in management of irrigated land.

The average size of farms in this association is about 480 acres. Gravel roads are on nearly all section lines. Paved U. S. Highway 136 crosses this association. Cash crops are sold at local elevators. Fattened hogs are sold at local auctions, and fattened cattle are trucked to larger terminal markets. The town of Franklin is in this association.

Descriptions of the Soils

This section describes each soil series in detail and then, briefly, each mapping unit in that series. Unless stated otherwise, 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 down to rock or other underlying material. Each series contains two descriptions of the profile. The first is brief and in terms familiar to a layman. The second is more detailed and is included for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for dry soil unless otherwise stated.

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

Preceding the name of each mapping unit is a symbol that 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 suitability group in which the mapping unit has been placed. The windbreak group and page where each capability unit or range site is described are listed in the "Guide to Mapping Units" at the back of this survey.

The approximate 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, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).

Broken Alluvial Land

Br—Broken alluvial land (0 to 60 percent slopes). This land type consists of frequently flooded, silty to clayey material on bottom lands along small streams throughout the county.

Broken alluvial land is made up of about 85 to 95 percent bottom lands and about 5 to 15 percent very steep slopes that are adjacent to the bottom lands. The areas on bottom lands are deeply channeled in places and contain layers that are stratified with light- and dark-colored material. The layers are silty to clayey and range in thickness from a fraction of an inch to a foot or more. The very steep areas on side slopes consist of calcareous silty material in which soil development is limited to a thin, slightly darkened surface layer. "Catsteps" are common.

After rains, Broken alluvial land is flooded for short periods of time, but the water runs off rapidly. The ground water is usually at a depth below 10 feet.

Included with this land type in mapping were small areas of Hobbs soils on bottom lands and, in places, Hord soils on remnants of old stream terraces. Also included were a few nearly level areas underlain by sand at a depth of about 12 inches.

Broken alluvial land is mainly used for grazing livestock. It is not suited to cultivated crops, because it has numerous trees, ditches, and channels and is subject to frequent flooding. Silt is deposited with each flooding, and grass is commonly damaged. Except where these areas are properly managed, weeds and brush are the dominant vegetation. Capability unit VIw–7, dryland; Silty Overflow range site; windbreak suitability group 10.

Butler Series

The Butler series consists of deep, nearly level, somewhat poorly drained soils in slightly depressional areas on uplands. These soils formed in loess.

In a representative profile the surface layer is very dark gray, very friable silt loam 12 inches thick. The subsurface layer is gray, very friable silt loam 2 inches thick. The subsoil, about 27 inches thick, is dark gray, very firm clay in the upper part, dark grayish brown, very firm silty clay in the middle part, and grayish brown, firm silty clay loam in the lower part. The underlying material, to a depth of 60 inches, is pale brown silt loam.

Butler soils have slow permeability and high available water capacity. Natural fertility is high, and organic-matter content is moderate. These soils absorb moisture easily until the surface layer is saturated. After this, moisture is absorbed slowly. These soils contain fine, elastic clay that holds some of the soil moisture under too much tension for it to be extracted by plants.

Butler soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to use for recreation.

Representative profile of Butler silt loam, 0 to 1 percent slopes, in native grasses, 1,056 feet north and 950 feet east of the southwest corner of sec. 13, T. 4 N., R. 16 W.:

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

Soil	Area	Extent
	Acres	*Percent*
Broken alluvial land	9,700	2.6
Butler silt loam, 0 to 1 percent slopes	1,500	.4
Campus complex, 9 to 30 percent slopes	7,300	2.0
Canyon-Campus loams, 9 to 30 percent slopes	1,850	.5
Coly-Uly silt loams, 3 to 9 percent slopes, eroded	14,300	3.9
Coly-Uly silt loams, 9 to 30 percent slopes	21,800	5.9
Detroit silt loam, 0 to 1 percent slopes	5,600	1.5
Fillmore silt loam, 0 to 1 percent slopes	1,550	.4
Gibbon silt loam, 0 to 2 percent slopes	2,000	.6
Gravelly land complex, 3 to 30 percent slopes	2,650	.7
Hall silt loam, 0 to 1 percent slopes	9,000	2.4
Hall silt loam, terrace, 0 to 1 percent slopes	460	.1
Hastings silt loam, 0 to 1 percent slopes	1,000	.3
Hersh-Valentine complex, 1 to 6 percent slopes	1,150	.3
Hersh-Valentine complex, 6 to 11 percent slopes	3,250	.9
Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes	5,300	1.4
Holdrege silt loam, 0 to 1 percent slopes	49,025	13.3
Holdrege silt loam, 1 to 3 percent slopes	50,475	13.6
Holdrege silt loam, 3 to 6 percent slopes	4,050	1.1
Holdrege silt loam, 6 to 9 percent slopes	4,150	1.1
Holdrege and Uly soils, 3 to 9 percent slopes, eroded	22,750	6.1
Hord silt loam, terrace, 0 to 1 percent slopes	4,100	1.1
Hord silt loam, terrace, 1 to 3 percent slopes	4,450	1.2
Inavale loamy sand, 0 to 3 percent slopes	2,400	.7
Inavale fine sandy loam, 0 to 3 percent slopes	780	.2
Kenesaw silt loam, 0 to 1 percent slopes	2.850	.8
Kenesaw silt loam, 1 to 3 percent slopes	7,500	2.0
Kenesaw silt loam, 3 to 6 percent slopes	2,550	.7
Kipson complex, 9 to 30 percent slopes	4,450	1.2
Marsh	226	.1
McCook fine sandy loam, 0 to 2 percent slopes	800	.2
McCook silt loam, 0 to 2 percent slopes	2,350	.6
Munjor loamy fine sand, 0 to 2 percent slopes	1,000	.3
Munjor fine sandy loam, 0 to 2 percent slopes	4,900	1.3
Nuckolls-Hobbs complex, 9 to 30 percent slopes	55,777	15.1
Nuckolls and Holdrege silt loams, 3 to 6 percent slopes	870	.2
Nuckolls and Holdrege silt loams, 6 to 9 percent slopes	7,800	2.1
Nuckolls and Holdrege soils, 3 to 9 percent slopes, eroded	6,300	1.7
Nuckolls and Meadin soils, 9 to 30 percent slopes	6,800	1.8
Riverwash	770	.2
Rough broken land, loess, 20 to 60 percent slopes	4,050	1.1
Rough stony land, 15 to 30 percent slopes	820	.2
Roxbury silt loam, 0 to 2 percent slopes	2,400	.7
Sandy alluvial land	4,800	1.3
Scott silt loam, 0 to 1 percent slopes	650	.2
Uly silt loam, 3 to 6 percent slopes	5.300	1.4
Uly silt loam, 6 to 11 percent slopes	6,900	1.9
Valentine loamy sand, hilly	1,900	.5
Valentine-Hersh complex, 11 to 30 percent slopes	3,050	.8
Wann fine sandy loam, 0 to 2 percent slopes	1,800	.5
Wann silt loam, 0 to 2 percent slopes	970	.3
Water	1,000	.3
Gravel pits	197	.1
Intermittent lakes	550	.1
Total	369,920	100.0

A—0 to 12 inches, very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; moderate medium granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A2—12 to 14 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

B21t—14 to 23 inches, dark gray (10YR 4/1) clay, very dark grayish brown (10YR 3/2) moist; few fine distinct light olive brown (2.5Y 5/4, moist) mottles; strong medium prismatic structure parting to strong medium blocky; very hard, very firm; dark coatings on faces of peds; neutral; gradual smooth boundary.

B22t—23 to 31 inches, dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; few fine distinct light olive brown (2.5Y 5/4, moist) mottles; strong medium prismatic structure parting to strong coarse blocky; very hard, very firm; thin coatings on faces of peds, neutral; clear smooth boundary.

B3—31 to 41 inches, grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure parting to moderate coarse blocky; hard, firm; soft white accumulations about 3 millimeters in diameter make up about 5 percent of the soil mass; violent effervescence; moderately alkaline; gradual smooth boundary.

C—41 to 60 inches, pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable; violent effervescence; moderately alkaline.

The A horizon ranges from 8 to 15 inches in thickness. The A1 and A2 horizons are slightly acid or neutral in reaction. The B2t horizon ranges from very dark gray to dark grayish brown. It is neutral or mildly alkaline in reaction. Depth to lime ranges from 26 to 50 inches.

Butler soils are near Scott, Fillmore, Detroit, and Holdrege soils. They are in shallower depressions and have better drainage than Scott and Fillmore soils. They have more clay in the B horizon and are more poorly drained than Holdrege soils. They have more clay in the upper part of the B horizon than Detroit soils and have an A2 horizon, which is not present in these soils.

Bu—Butler silt loam, 0 to 1 percent slopes. This soil has a claypan. Areas range from 5 to 200 acres in size.

Included with this soil in mapping were a few small areas of Detroit silt loam and Fillmore silt loam.

When dryfarmed, this soil is droughty because the slowly permeable clayey subsoil releases moisture slowly to plants. Soil blowing is a hazard if the surface is not protected. Runoff from adjacent areas causes ponding in some places. Runoff is very slow. Surface drainage is needed in some areas before this soil can be irrigated.

Most of the acreage of this soil is in crops. A large acreage is irrigated. Corn, grain sorghum, alfalfa, and wheat are the chief crops. Capability units IIw–2, dryland, and IIw–2, irrigated; Clayey range site; windbreak suitability group 2.

Campus Series

The Campus series consists of moderately deep, moderately steep and steep, well drained soils on uplands. These soils formed in material that weathered in place from limy sandstone.

In a representative profile the surface layer is gray, friable loam 16 inches thick. The upper 9 inches of the underlying material is light gray gravelly loam that has an abundance of lime. Below a depth of 25 inches is white, limy sandstone bedrock that has clay loam material in fractures and crevices.

Campus soils have moderate permeability and low available water capacity. The organic-matter content is moderately low, and natural fertility is medium. These soils absorb moisture easily until the material above the bedrock is saturated. They release moisture readily to plants.

Campus soils are well suited to native grasses. They are too steep for the common cultivated crops. They are also suited to trees and shrubs, to habitat for wildlife, and to use for recreation.

Representative profile of Campus loam, in an area of Campus complex, 9 to 30 percent slopes, in native grass, 1,584 feet west and 3,010 feet south of the northeast corner of sec. 34, T. 1 N., R. 15 W.:

A11—0 to 8 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, friable; small hard limy sandstone chips make up about 5 percent of the soil mass; strong effervescence; mildly alkaline; clear smooth boundary.

A12—8 to 16 inches, gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate fine subangular blocky structure; slightly hard, friable; small hard limy sandstone fragments make up about 10 percent of the soil mass; violent effervescence; mildly alkaline; clear smooth boundary.

C1ca—16 to 25 inches, light gray (10YR 7/1) gravelly loam; gray (10YR 5/1) moist; massive; slightly hard, firm; small hard limy sandstone chips and soft limy fragments make up 35 to 40 percent of the soil mass; violent effervescence; moderately alkaline; abrupt wavy boundary.

C2—25 to 34 inches, white (10YR 8/1) limy sandstone; clay loam in fractures and crevices.

The A horizon ranges from 5 to 16 inches in thickness. The A12 horizon is dominantly loam, but in places it is clay loam. The C1ca horizon ranges from 6 to 20 inches in thickness. Depth to free carbonates ranges from 0 to 7 inches, depth to the C1ca horizon from 11 to 24 inches, and depth to limy sandstone from 20 to 40 inches.

Campus soils are near Canyon and Kipson soils. They are deeper to bedrock than these soils. They formed in limy sandstone, whereas Kipson soils formed in chalky shale and soft limestone.

CaF—Campus complex, 9 to 30 percent slopes. This complex is on ridges and side slopes between intermittent drainageways. It is 50 to 75 percent Campus loam, 20 to 40 percent Canyon loam, and about 10 percent other soils. The Campus soils are on the upper part of the side slopes, and Canyon soils are on the lower part. Areas range from 60 to 1,000 acres in size. A Campus soil in an area of this complex has the profile described as representative of the series.

Included with these soils in mapping were areas of Kipson soils on the extreme lower part of the side slopes below Canyon soils and adjacent to the intermittent drainageways. Also included were areas of Nuckolls, Coly, and Uly soils on the crests of ridges and on the upper part of side slopes above Campus soils.

Water erosion is a severe hazard in areas of this complex. Soil blowing is a hazard where the surface layer is not protected by plant cover. Runoff is medium to rapid, depending on the amount of plant cover.

Nearly all the acreage of this complex is in native grasses and is used for range. Areas are too steep for the common cultivated crops. Capability unit VIe–1, dryland; Limy Upland range site; windbreak suitability group 10.

Canyon Series

The Canyon series consists of shallow, moderately steep and steep, well drained, loamy soils on uplands. These soils formed in material that weathered from limy, soft sandstone.

In a representative profile the surface layer is grayish brown, friable loam 5 inches thick. Beneath this is about 4 inches of light brownish gray loam. The upper part of the underlying material is white loam that contains many limy sandstone fragments. Beneath this, at a depth of 14 inches, is white limy sandstone.

Canyon soils have moderate permeability and very low available water capacity. The organic-matter content is moderately low, and natural fertility is low. These soils absorb moisture easily but only until the material above the bedrock is saturated. They release moisture readily to plants.

Canyon soils are suited to native grasses. They produce good habitat for wildlife and have limited recreational uses. Canyon soils are too shallow for successful plantings of trees and shrubs. They are not suited to common cultivated crops.

Representative profile of Canyon loam, in an area of Canyon-Campus loams, 9 to 30 percent slopes, in native grasses, 1,320 feet south and 1,056 feet east of the northwest corner of sec. 31, T. 1 N., R. 14 W.:

A—0 to 5 inches, grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; few worm castings; few small calcareous sandstone fragments; violent effervescence; mildly alkaline; clear smooth boundary.

AC—5 to 9 inches, light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; common fine roots; few small and medium calcareous sandstone fragments; violent effervescence; moderately alkaline; clear smooth boundary.

C1—9 to 14 inches, white (10YR 8/2) loam, light gray (10YR 7/2) moist; massive; hard, friable; few small to large calcareous sandstone fragments; violent effervescence; moderately alkaline; abrupt wavy boundary.

C2—14 to 20 inches, white (10YR 8/2) soft fractured sandstone; violent effervescence.

The A horizon ranges from 3 to 6 inches in thickness and from dark grayish brown to very pale brown in color. It is dominantly loam, but in places it is very fine sandy loam and silt loam. The AC horizon ranges from grayish brown to very pale brown in color. It is very fine sandy loam,

loam, or silt loam. The C horizon is loam or silt loam, and it ranges from light brownish gray to white in color.

Canyon soils are near Campus and Kipson soils. They are shallower over bedrock than Campus soils. They formed in calcareous sandstone, whereas Kipson soils formed in chalky shale or soft limestone.

CnF—Canyon-Campus loams, 9 to 30 percent slopes. This complex is on the side slopes to intermittent drainageways and on crests of ridges. It is about 60 to 80 percent Canyon loam and 10 to 30 percent Campus loam. The remaining 10 percent is Kipson soils, very shallow soils that formed in limy sandstone, and areas of Broken alluvial land. Canyon soils are on the lower part of the side slopes below the Campus soils and adjacent to the intermittent drainageways. Campus soils are on the upper part of the side slopes and on ridgetops. Areas range from 20 to 700 acres in size.

A Canyon soil in an area of this complex has the profile described as representative of the series.

The shallow depth of the Canyon soils is a major limitation. Water erosion and soil blowing are hazards where the surface is not protected by plant cover. Runoff is medium.

Nearly all areas of this complex are in native grasses and are used for grazing livestock. Capability unit VIs–4, dryland; Canyon soil in Shallow Limy range site and Campus soil in Limy Upland range site; windbreak suitability group 10.

Coly Series

The Coly series consists of deep, gently sloping to steep, somewhat excessively drained soils on uplands. These soils formed in loess.

In a representative profile the surface layer is grayish brown, very friable silt loam 5 inches thick. Beneath this is about 5 inches of light brownish gray silt loam. The underlying material, to a depth of 60 inches, is light gray silt loam.

Coly soils have moderate permeability and high available water capacity. Organic-matter content and natural fertility are low. These soils release moisture readily to plants.

The Coly soils are suited to cultivated crops where slope is less than 9 percent. They are also suited to native grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Coly silt loam, in an area of Coly-Uly silt loams, 9 to 30 percent slopes, in native grasses, 2,376 feet south and 264 feet east of the northwest corner of sec. 22, T. 4 N., R. 14 W. (fig. 7) :

A—0 to 5 inches, grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

AC—5 to 10 inches, light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; soft white accumulations of lime 2 to 5 millimeters in diameter and white myceliumlike threads; violent effervescence; moderately alkaline; gradual smooth boundary.

C—10 to 60 inches, light gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; soft white accumulations of lime 2 to 10 millimeters in diameter and white myceliumlike threads; violent effervescence; moderately alkaline.

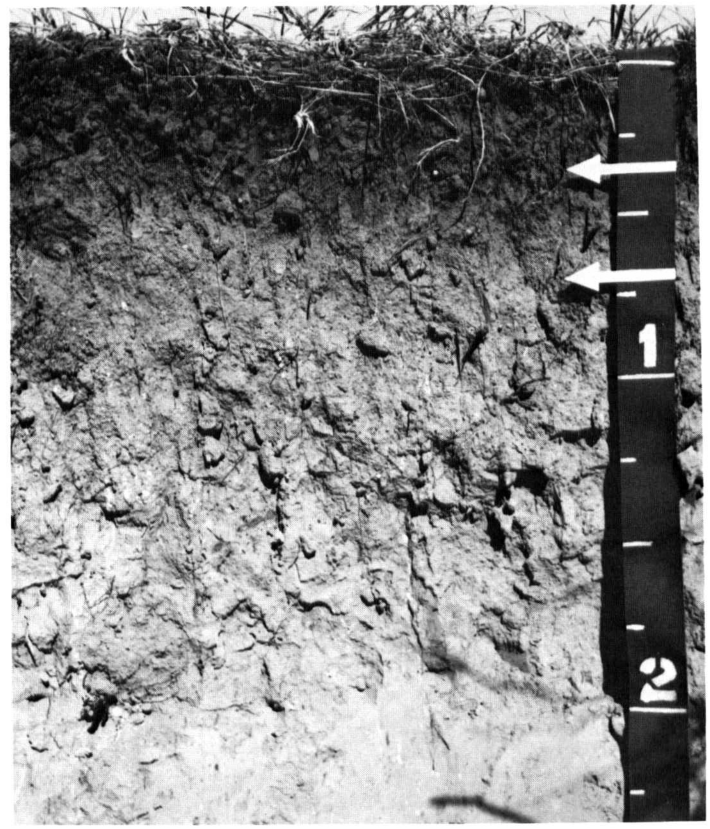

Figure 7.—**Profile of a Coly silt loam.**

The A horizon ranges from 3 to 6 inches in thickness, and the AC horizon ranges from 0 to 8 inches in thickness. Depth to carbonates ranges from 0 to 8 inches.

Coly soils are near Holdrege, Kenesaw, Nuckolls, and Uly soils. They have a thinner A horizon and have lime nearer the surface than these soils, and they lack a B horizon. They formed in Peoria loess, whereas Nuckolls soils formed in material of the Loveland Formation.

CoD2—Coly-Uly silt loams, 3 to 9 percent slopes, eroded. This complex is on ridgetops and side slopes that border intermittent drainageways. It is about 45 to 70 percent Coly soils, 25 to 45 percent Uly soils, and 5 to 15 percent other soils. The Coly soil is on the ridgetops and upper side slopes. The Uly soil is on the lower side slopes. Areas range from 5 to 600 acres in size. The Coly and Uly soils in this complex have a profile similar to the one described as representative of their respective series, but their surface layer is thinner and lighter colored because erosion has removed most of the original, dark-colored surface layer. Tillage has mixed the remaining surface layer with the transitional layer of the Coly soil and with the subsoil of the Uly soil. In some places the underlying material is at the surface.

Included with this complex in mapping were small areas of a Uly silt loam that is more strongly sloping.

Water erosion is a severe hazard. Soil blowing is a hazard where the surface is not protected by plant cover. The soils are fairly easy to work. Runoff is medium, and small gullies are common.

Nearly all the acreage of this complex is cultivated and is used mainly for wheat and grain sorghum. Some corn and alfalfa are also grown. A few areas have been reseeded to native grasses. Capability units IVe–9, dryland, and IVe–6, irrigated; Coly soil in Limy Upland range site and Uly soil in Silty range site; windbreak suitability group 5.

CoF—Coly-Uly silt loams, 9 to 30 percent slopes. This complex is on side slopes that border intermittent drainageways. It is about 40 to 60 percent Coly silt loam, 20 to 40 percent Uly silt loam, and 5 to 15 percent other soils. The Coly soil is on the upper part of the side slopes, and the Uly soil is on the lower part. Areas range from 15 to 400 acres in size. A Coly soil in an area of this complex has the profile described as representative of the series. A Uly soil has a profile similar to the one described as representative of the series, but the surface layer is thinner.

Included with these soils in mapping were areas of eroded soils that have a thin, lighter colored surface layer. Also included were small areas of Nuckolls soils on low side slopes and Hobbs soils on the bottom of narrow drainageways.

Water erosion is a very severe hazard. Soil blowing is also a hazard if the surface is not protected by plant cover. Runoff is medium to rapid, depending on the slope gradient and plant cover.

Most of the acreage of this complex is in native grasses and is used for range. Only a few areas are cultivated. Because the hazard of erosion is so severe, many areas that were cultivated have been reseeded to native grasses. Capability unit VIe–9, dryland; Coly soil in Limy Upland range site and Uly soil in Silty range site; windbreak suitability group 10.

Detroit Series

The Detroit series consists of deep, nearly level, moderately well drained soils on uplands. These soils formed in loess.

In a representative profile the surface layer is dark gray, friable silt loam 18 inches thick. The subsoil is very firm silty clay about 17 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material, at a depth of 35 inches and to a depth of 60 inches, is pale brown silt loam.

Detroit soils have slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. These soils absorb moisture easily until the surface layer is saturated. They contain fine, elastic clay that holds some soil moisture under too much tension to be extracted by plant roots.

Detroit soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Detroit silt loam, 0 to 1 percent slopes, in native grasses, 2,112 feet south and 634 feet west of the northeast corner of sec. 23, T. 3 N., R. 15 W.:

A11—0 to 15 inches, dark gray (10YR 4/1) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

A12—15 to 18 inches, dark gray (10YR 4/1) light silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

B21t—18 to 28 inches, dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse blocky structure; very hard, very firm; organic films and stains on faces of peds; neutral; gradual smooth boundary.

B22t—28 to 35 inches, grayish brown (10YR 5/2) light silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine and coarse blocky structure; very hard, very firm; organic stainings and thin films on faces of peds; neutral; clear smooth boundary.

C—35 to 60 inches, pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, very friable; few small lime concretions; violent effervescence; mildly alkaline.

The A horizon ranges from 9 to 18 inches in thickness. The B2t horizon ranges from 13 to 39 inches in thickness. It is heavy silty clay loam to silty clay. Depth to carbonates ranges from 22 to 50 inches.

Detroit soils are near Butler, Fillmore, Hastings, Holdrege, and Hord soils. They have less clay in the B2t horizon than the Butler and Fillmore soils. They lack an A2 horizon, which Fillmore soils have. They lack mottles in the B horizon, which Butler soils have. They have more clay in the B2 horizon than Hastings, Holdrege, and Hord soils. They are dark-colored to a greater depth than Hastings soils.

De—Detroit silt loam, 0 to 1 percent slopes. This soil is on the loess uplands. It is relatively flat and has numerous small microdepressions. Water stands in the microdepressions for short periods after heavy rains. Areas range from 20 to 800 acres in size.

Included with this soil in mapping were a few areas of Hall soils that have less clay in the subsoil than this soil, small areas of Butler silt loam in shallow basins, and small areas of Fillmore silt loam in depressions.

Shortage of rainfall is a limitation to dryfarmed crops. Soil blowing is a hazard where the surface is not protected by plant cover. Runoff is slow.

Most of the acreage of this soil is cultivated. Both dryland and irrigation management are used. A few areas are in native grasses. Capability units IIc–1, dryland, and I–2, irrigated; Silty Lowland range site; windbreak suitability group 4.

Fillmore Series

The Fillmore series consists of deep, nearly level, poorly drained soils in depressions on the uplands. These soils formed in loess.

In a representative profile the surface layer is dark gray, very friable silt loam 11 inches thick. The subsurface layer is gray, very friable silt loam about 5 inches thick. The subsoil is about 30 inches thick. It is gray, very firm silty clay in the upper part, grayish brown, very firm silty clay in the middle part, and grayish brown, firm silty clay loam in the lower part. The underlying material is at a depth of 46 inches. It is very pale brown silt loam to a depth of 60 inches.

Fillmore soils have high available water capacity and very slow permeability. Natural fertility is high, and organic-matter content is moderate. These soils absorb moisture easily until the surface layer is saturated. They contain fine, elastic clay that holds some soil moisture under too much tension to be extracted by plants.

Fillmore soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Fillmore silt loam, 0 to 1 percent slopes, 2,112 feet east and 100 feet south of the northwest corner of sec. 7, T. 4 N., R. 16 W.:

A1—0 to 11 inches, dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, very friable; slightly acid; clear smooth boundary.

A2—11 to 16 inches, gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) moist; strong medium and structure; soft, very friable; slightly acid; abrupt smooth boundary.

B21t—16 to 24 inches, gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; strong medium and fine blocky structure; very hard, very firm; shiny surfaces on faces of peds; many shotlike black pellets of iron and manganese; neutral; clear smooth boundary.

B22t—24 to 34 inches, grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse and medium blocky structure; very hard, firm; shiny surfaces on faces of peds; many shotlike pellets of iron or manganese; neutral; clear smooth boundary.

B3—34 to 46 inches, grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse and medium subangular blocky structure; hard, firm; mildly alkaline; gradual smooth boundary.

C—46 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; slight effervescence; moderately alkaline.

The A1 horizon ranges from 6 to 12 inches in thickness, the A2 horizon from 4 to 8 inches, and the B horizon from 25 to 35 inches. The B2t horizon is neutral or mildly alkaline in reaction.

Fillmore soils are near Scott, Butler, Hastings, Detroit, Holdrege, and Hall soils. Fillmore soils have a thicker A horizon than Scott soils and are less frequently flooded. They have poorer drainage than Butler soils. They have more clay in the B horizon than Detroit, Hastings, Holdrege, and Hall soils and have an A2 horizon that these soils do not have.

Fm—Fillmore silt loam, 0 to 1 percent slopes. This soil is in basinlike depressions on loess uplands. It has a claypan. Areas are 5 to 60 acres in size.

Included with this soil in mapping were a few small areas of Butler silt loam, Detroit silt loam, and Scott silt loam.

This soil is occasionally flooded, and water is ponded for short periods after heavy rains. Runoff is very slow, so most of the water is lost through evaporation. This soil is droughty late in summer.

Nearly all the acreage of this soil is in cultivated crops. Both dryland and irrigation management are used. Corn, wheat, alfalfa, and grain sorghum are the major crops. A few small areas are in native grasses. Capability units IIIw–2, dryland, and IIIw–2, irrigated; Clayey Overflow range site; windbreak suitability group 2.

Gibbon Series

The Gibbon series consists of deep, nearly level, somewhat poorly drained soils on bottom lands. These soils formed in alluvium. They have a seasonal high water table that is at a depth of 2 to 4 feet in most years, but late in summer the water table may fall to a depth of about 6 feet.

In a representative profile the plow layer is gray, friable silt loam 7 inches thick. The next layer is 8 inches of dark gray, very firm silty clay loam. Below this is 9 inches of light brownish gray, firm silt loam. The upper part of the underlying material, at a depth of 24 inches, is light gray very fine sandy loam. The lower part of the underlying material, between depths of 42 and 60 inches, is light gray very fine sandy loam.

Gibbon soils have moderately slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. These soils readily absorb moisture; they readily release moisture to plants.

Gibbon soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Gibbon silt loam, 0 to 2 percent slopes, in a cultivated field, 3,432 feet south and 175 feet east of the northwest corner of sec. 4, T. 1 N., R. 15 W.:

Ap—0 to 7 inches, gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; moderate very fine granular structure; slightly hard, friable, nonsticky; violent effervescence; moderately alkaline; abrupt smooth boundary.

A12—7 to 15 inches, dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; strong fine blocky structure; very hard, very firm, very sticky; violent effervescence; moderately alkaline; abrupt wavy boundary.

A3ca—15 to 24 inches, light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak very fine granular structure; slightly hard, firm, slightly sticky; soft and slightly hard white lime accumulations; violent effervescence; strongly alkaline; clear smooth boundary.

C1ca—24 to 42 inches, light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; common fine distinct strong brown (7.5YR 5/6) and yellow (2.5Y 7/6) moist mottles; massive; soft, very friable, nonsticky; violent effervescence; strongly alkaline; clear smooth boundary.

C2—42 to 60 inches, light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; common coarse prominent strong brown (7.5YR 5/8) and yellow (2.5Y 7/8) moist mottles; massive; soft, very friable, nonsticky; violent effervescence; very strongly alkaline.

The A horizon ranges from 12 to 28 inches in thickness. It is dominantly silt loam in texture, but it ranges to silty clay loam in places.

Gibbon soils are near Wann, McCook, and Roxbury soils. Gibbon soils have more clay and less sand in the C horizon than Wann soils. They have poorer drainage than McCook and Roxbury soils.

Gb—Gibbon silt loam, 0 to 2 percent slopes. This soil is on bottom lands. The areas range from 5 to 240 acres in size.

Included with this soil in mapping were a few small areas of Wann silt loam and Roxbury silt loam.

The chief limitation of this soil is wetness caused by a high water table. Wetness commonly delays tillage in spring. Runoff is slow.

Nearly all the acreage of this soil is cultivated. Corn, grain sorghum, and alfalfa are the principal crops. A few areas are irrigated. Capability units IIw–4, dryland, and IIw–6, irrigated; Subirrigated range site; windbreak suitability group 2.

Gravelly Land

GcF—Gravelly land complex, 3 to 30 percent slopes. This complex is on convex hillsides adjacent to drainageways on uplands. It is about 50 to 75 percent areas that have sand and gravel at or near the surface, 15 to 25 percent Meadin soils, and 10 to 20 percent Valentine soils. Areas range from 20 to 640 acres in size. A Meadin soil in this unit has a profile similar to the one described as representative of the series, but the surface layer is loamy sand.

Included with this land type in mapping were a few small areas of deep and moderately deep silty material over mixed sand and gravel. Also included were a few small gravel pits.

Very low available water capacity is the main hazard. Soil blowing is a hazard if the surface is not protected by plant cover. Natural fertility is low, and the organic-matter content is very low. Permeability is very rapid. Runoff is very slow, and internal drainage is excessive.

Almost all of the acreage of this complex is in native grasses and is used as range. The areas can be used as a source of sand and gravel. Capability unit VIIs–4, dryland; Shallow to Gravel range site; windbreak suitability group 10.

Hall Series

The Hall series consists of deep, nearly level, well drained silty soils on stream terraces and uplands. These soils formed in loess or loesslike, stratified alluvium.

In a representative profile the surface layer is dark grayish brown, very friable silt loam 14 inches thick. The subsoil, about 24 inches thick, is dark grayish brown, friable silt loam in the upper part, grayish brown, firm silty clay loam in the middle part, and light brownish gray, friable silt loam in the lower part. The underlying material, at a depth of 38 inches, is light gray silt loam.

Hall soils have moderately slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. These soils release moisture readily to plants.

Hall soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Hall silt loam, terrace, 0 to 1 percent slopes, in a cultivated field, 1,056 feet south and 75 feet east of the northwest corner of sec. 31, T. 2 N., R. 14 W.:

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

A12—6 to 14 inches, dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

B1—14 to 18 inches, dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B21t—18 to 25 inches, grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm; few shiny faces on peds; neutral; clear smooth boundary.

B22t—25 to 32 inches, grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; common shiny faces on peds; neutral; clear smooth boundary.

B3—32 to 38 inches, light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

C1—38 to 50 inches, light gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; weak coarse prismatic structure; soft, very friable; mildly alkaline; clear wavy boundary.

C2—50 to 60 inches, light gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; massive; soft, very friable; violent effervescence; moderately alkaline.

The solum ranges from 24 to 54 inches in thickness. The A horizon ranges from dark gray to grayish brown in color. It is dominantly silt loam, but in areas it is loam and light silty clay loam. Depth to lime ranges from 30 inches to 60 inches or more.

Hall soils are near Hord soils on stream terraces and Holdrege and Detroit soils on uplands. Hall soils have a finer textured B horizon than Hord and Holdrege soils. They have less clay in their B horizon than Detroit soils.

Ha—Hall silt loam, 0 to 1 percent slopes. This deep soil is on loess uplands. Areas range from 10 to 640 acres in size.

Included with this soil in mapping were a few small areas of Detroit silt loam and of Holdrege silt loam.

The low annual precipitation is the major limiting factor when this soil is dryfarmed. Soil blowing is a hazard if the surface is not protected. Runoff is slow. This soil is easy to work.

Nearly all the acreage is cultivated. A large acreage is irrigated. Cultivated crops are well suited. Corn, grain sorghum, wheat, and alfalfa are the principal crops. Capability units IIc–1, dryland, and I–4, irrigated; Silty range site; windbreak suitability group 4.

Hb—Hall silt loam, terrace, 0 to 1 percent slopes. This soil is on stream terraces. Areas range from 35 to 320 acres in size. This soil has the profile described as representative of the series.

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

The low annual precipitation is a common limitation when this soil is dryfarmed. Soil blowing is a hazard where the surface is not protected by plant cover. Runoff is slow.

Most of the acreage of this soil is cultivated. Both dryland and irrigation management are used. Wheat, alfalfa, grain sorghum, and corn are the main crops. Capability units IIc–1, dryland, and I–4, irrigated; Silty Lowland range site; windbreak suitability group 1.

Hastings Series

The Hastings series consists of deep, nearly level, moderately well drained soils on uplands. These soils formed in loess.

In a representative profile the surface layer is dark grayish brown, very friable silt loam 9 inches thick. The subsoil, about 28 inches thick, is dark grayish brown, friable silty clay loam in the upper part, grayish brown and pale brown, firm light silty clay and heavy silty clay loam in the middle part, and pale brown, friable silty clay loam in the lower part. The underlying material, at a depth of 37 inches, is very pale brown silt loam.

Hastings soils have moderately slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. These soils release moisture readily to plants.

Hastings soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Hastings silt loam, 0 to 1 percent slopes, in a cultivated field, 230 feet north and 260 feet east of the southwest corner of sec. 24, T. 4 N., R. 14 W. (fig. 8):

Ap—0 to 9 inches, dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

B1—9 to 13 inches, dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate very fine blocky; slightly hard, friable; neutral; clear smooth boundary.

B21t—13 to 21 inches, grayish brown (10YR 5/2) light silty clay, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to strong very fine blocky; hard, firm; thin continuous films on faces of peds; neutral; clear smooth boundary.

B22t—21 to 27 inches, pale brown (10YR 6/3) heavy silty clay loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to strong fine blocky; hard, firm; neutral; clear smooth boundary.

B3—27 to 37 inches, pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; gradual smooth boundary.

C1—37 to 56 inches, very pale brown (10YR 7/3) silt loam, yellowish brown (10YR 5/4) moist; weak coarse

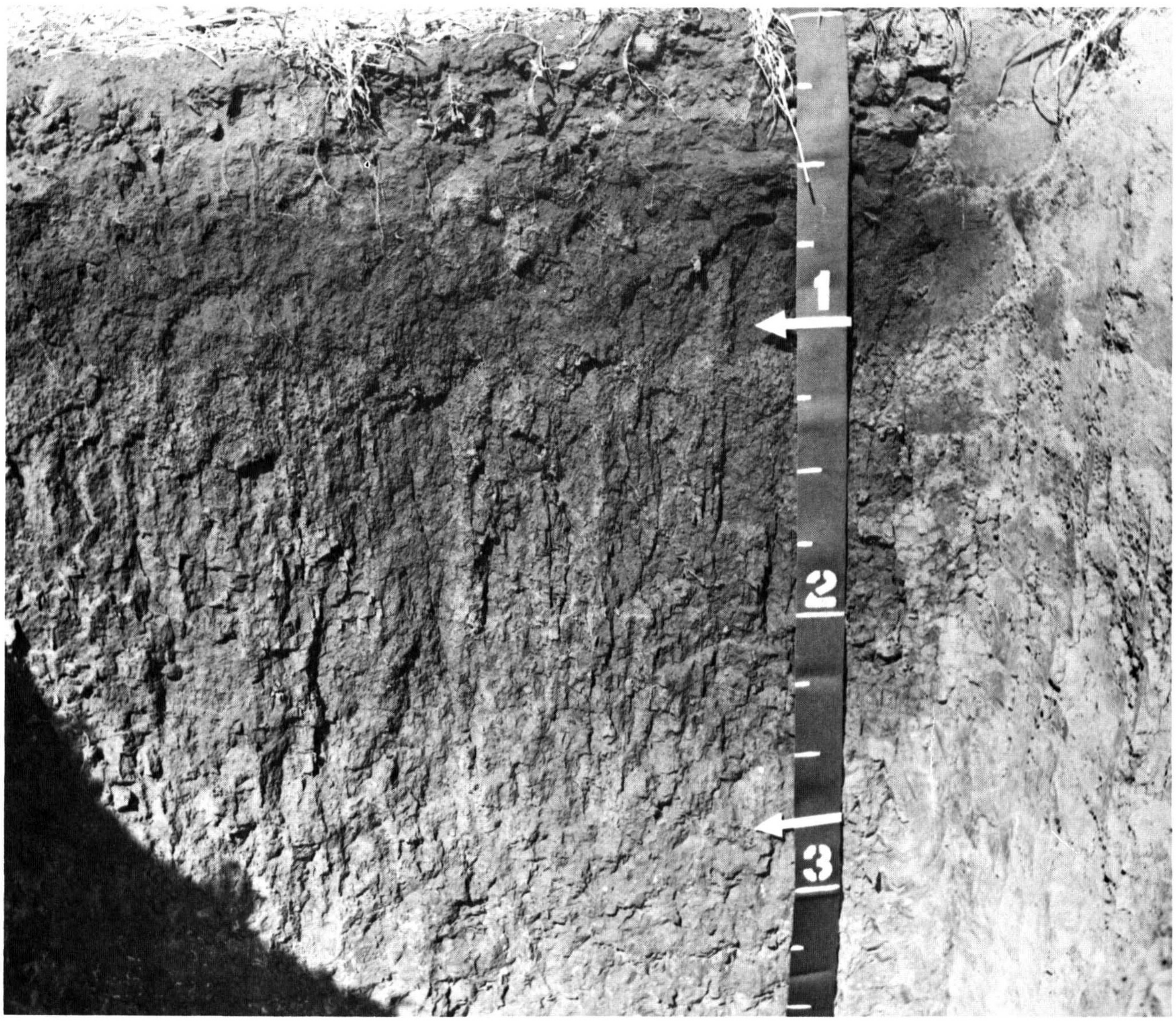

Figure 8.—**Profile of a Hastings silt loam.**

prismatic structure; soft, very friable; mildly alkaline; clear smooth boundary.

C2ca—56 to 60 inches, very pale brown (10YR 7/3) silt loam, yellowish brown (10YR 5/4) moist; massive; soft, very friable; few soft white accumulations of lime about 2 millimeters in diameter; few myceliumlike threads and filaments of lime; violent effervescence; moderately alkaline.

The A horizon ranges from 8 to 12 inches in thickness, the B2t horizon from 12 to 20 inches, and the solum from 30 to 50 inches. Depth to carbonates ranges from 36 to 60 inches.

Hastings soils are near Butler, Detroit, Fillmore, and Holdrege soils. They have less clay in the B horizon than Butler and Detroit soils. They are better drained and lack the A2 horizon, which is in Fillmore soils. They have more clay in the B2 horizon than Holdrege soils.

Hc—Hastings silt loam, 0 to 1 percent slopes. This soil is on loess uplands. Areas range from 10 to 700 acres in size.

Included with this soil in mapping were a few small areas of Fillmore silt loam, in depressions, and of Holdrege silt loam, Detroit silt loam, and Hord silt loam.

When this soil is dryfarmed, a shortage of rainfall is the main limitation in most years. Soil blowing is a hazard where the surface is not protected by plant cover. Runoff is slow.

This soil is used for crops under both dryland and irrigation management. Corn, wheat, grain sorghum, and alfalfa are the principal crops. Capability units IIc–1, dryland, and I–4, irrigated; Silty range site; windbreak suitability group 4.

Hersh Series

The Hersh series consists of deep, very gently sloping to strongly sloping, well drained soils on uplands. These soils formed in material deposited by wind. Most areas have a hummocky topography.

In a representative profile the surface layer is gray, very friable fine sandy loam 8 inches thick. Beneath this is a transition layer of grayish-brown sandy loam that is about 8 inches thick. The upper part of the underlying material is pale brown sandy loam, and the lower part is pale brown loamy sand to a depth of 60 inches.

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

Hersh soils are suited to cultivated crops, and they respond well to irrigation. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Hersh fine sandy loam in an area of Hersh-Valentine complex, 1 to 6 percent slopes, in native grasses, 1,056 feet north and 1,584 feet east of the southwest corner of sec. 18, T. 4 N., R. 14 W.:

A—0 to 8 inches, gray (10YR 5/1) fine sandy loam, dark gray (10YR 4/1) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

AC—8 to 16 inches, grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; neutral; gradual smooth boundary.

C1—16 to 40 inches, pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, very friable; neutral; diffuse smooth boundary.

C2—40 to 60 inches, pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; single grained; loose; neutral.

The A horizon ranges from 5 to 12 inches in thickness. The AC horizon ranges from 3 to 12 inches in thickness. It is fine sandy loam, sandy loam, or loamy very fine sand. The C horizon is fine sandy loam, sandy loam, or loamy sand.

Hersh soils in Franklin County contain a higher percent of sand than is defined as within the range for the Hersh series. This difference, however, does not alter their usefulness and behavior.

Hersh soils are near Valentine and Kenesaw soils. They have less sand in the A and AC horizons than Valentine soils. They have more sand throughout the profile than Kenesaw soils.

HdC—Hersh-Valentine complex, 1 to 6 percent slopes. This complex is on low hills and in hummocky areas on uplands. It is about 50 to 70 percent Hersh soils, 20 to 40 percent Valentine soils, and 5 to 15 percent other soils. Hersh soils are in the low areas between hummocks and on the lower part of hillsides. Valentine soils are on the crests of hummocks and on the upper part of hillsides. Areas range from 10 to 80 acres in size.

A Valentine soil in this complex has a profile similar to the one described as representative of the Valentine series, but the surface layer is loamy fine sand or loamy sand.

Included with these soils in mapping were a few small areas of Valentine loamy sand, hilly.

Soil blowing is the principal hazard. Low natural fertility and low available water capacity tend to limit plant growth. These soils are droughty, if dryfarmed, but they respond well to irrigation. Where they are irrigated, applying water effectively and maintaining fertility are concerns in management.

Most areas of these soils are in native grasses and are used as range. Some areas are cultivated; the crops grown are grain sorghum, wheat, corn, and alfalfa. Capability units IIIe–3, dryland, and IIIe–8, irrigated; Hersh soil in Sandy range site and Valentine soil in Sands range site; windbreak suitability group 7.

HdD—Hersh-Valentine complex, 6 to 11 percent slopes. This complex is in hummocky areas on uplands. It is about 45 to 65 percent Hersh soils, 30 to 50 percent Valentine soils, and 10 percent or less other soils. The Hersh soils are in the low areas between hummocks and on the lower part of hillsides. Valentine soils are on the crests of hummocks and on the upper part of the hillsides. Areas range from 10 to 160 acres in size. A Valentine soil in this complex has a profile similar to the one described as representative of the Valentine series, but the surface layer is loamy fine sand or loamy sand.

Included with these soils in mapping were a few small areas of Valentine loamy sand, hilly.

The principal hazard is soil blowing. Low available water capacity and low natural fertility tend to limit plant growth. Where dryfarmed, these soils are droughty, but they respond well to irrigation. Where crops are irrigated, maintaining fertility and selecting the proper method of water distribution are the main concerns in management. Sprinkler irrigation is well suited.

Nearly all of the acreage of this mapping unit is in native grasses and is used as range. Cultivated areas are used for grain sorghum, wheat, corn, and alfalfa. Capability units IVe–3, dryland, and IVe–8, irrigated; Hersh soil in Sandy range site and Valentine soil in Sands range site; windbreak suitability group 7.

Hobbs Series

The Hobbs series consists of deep, nearly level, moderately well drained soils on the bottom of narrow drainageways on uplands. These soils formed in silty alluvium that was washed from the adjacent uplands. They are occasionally flooded.

In a representative profile (fig. 9) the surface layer is dark gray, very friable and friable silt loam 27 inches thick. Beneath this is a transition layer of grayish brown silt loam 18 inches thick. The underlying material between depths of 45 and 60 inches is light brownish gray silt loam.

Hobbs soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. Hobbs soils release moisture readily to plants.

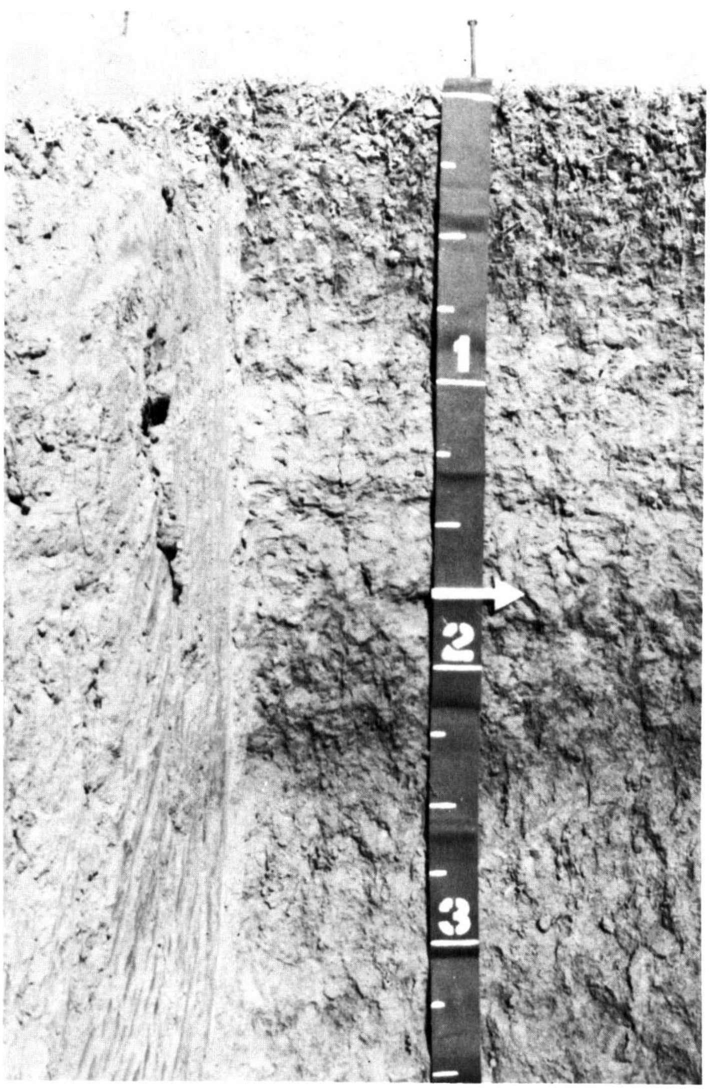

Figure 9.—**Profile of a Hobbs silt loam.**

Hobbs soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes, in a cultivated field, 1,056 feet north and 528 feet west of the southeast corner of sec. 8, T. 3 N., R. 13 W.:

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

A12—8 to 27 inches, stratified dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak medium granular structure; hard, friable; neutral; gradual smooth boundary.

AC—27 to 45 inches, grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; stratified with thin layers of darker colored silt loam; few faint reddish brown (5YR 5/4, moist) mottles; weak coarse subangular blocky structure; slightly hard, friable; neutral; diffuse smooth boundary.

C—45 to 60 inches, light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; mildly alkaline.

The solum ranges from 25 to 45 inches in thickness. Free carbonates are generally lacking above a depth of 40 inches, except where recent calcareous material is deposited on the surface.

Hobbs soils are near McCook, Roxbury, and Munjor soils. They contain less sand and more silt throughout the profile than McCook and Munjor soils. They lack lime in the A and AC horizons, whereas Roxbury soils have lime in these horizons.

Hf—Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes. This soil is in the bottom of narrow drainageways. It is occasionally flooded. It has the profile described as representative of the series. Areas are long and narrow and range from 15 to 300 acres in size.

Included with this soil in mapping were a few small areas of McCook silt loam and Roxbury silt loam.

The major hazard to crops on this soil is flooding. Runoff is medium.

Most of the acreage of this soil is in crops, mainly corn, grain sorghum, alfalfa, and wheat. It is under both dryland and irrigation management. Crops generally receive some benefit from the additional moisture of the floodwater, if flooding is not too rapid. Capability units IIw–3, dryland, and IIw–6, irrigated; Silty Overflow range site; windbreak suitability group 1.

Holdrege Series

The Holdrege series consists of deep, nearly level to strongly sloping, well drained soils on uplands. These soils formed in loess.

In a representative profile (fig. 10) the surface layer is grayish brown and dark grayish brown, very friable silt loam 13 inches thick. The subsoil, about 21 inches thick, is grayish brown, firm silty clay loam in the upper part; brown, firm silty clay loam in the middle part; and pale brown, friable silt loam in the lower part. The underlying material, between the depths of 34 and 60 inches, is very pale brown silt loam.

Holdrege soils have moderate permeability and high available water capacity. The organic-matter content

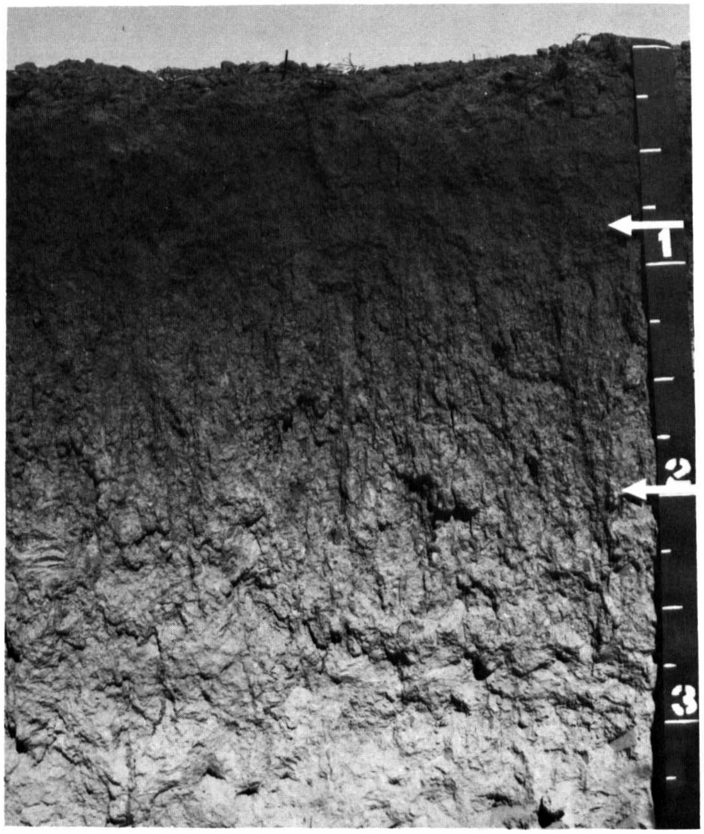

Figure 10.—**Profile of a Holdrege silt loam.**

is moderate, and natural fertility is high. These soils release moisture readily to plants.

Holdrege soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and recreational uses.

Representative profile of Holdrege silt loam, 0 to 1 percent slopes, in a cultivated field, 800 feet north and 500 feet east of the southwest corner of sec. 22, T. 4 N., R. 14 W.:

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

A12—5 to 13 inches, dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B21t—13 to 19 inches, grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure parting to moderate medium granular; hard, firm; neutral; clear smooth boundary.

B22t—19 to 26 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; mildly alkaline; clear smooth boundary.

B3—26 to 34 inches, pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C1ca—34 to 44 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure; soft, very friable; many medium soft white lime accumulations; many cleavage planes coated with carbonates; violent effervescence; moderatelv alkaline; clear smooth boundary.

C2—44 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure; soft, very friable; few small soft white lime accumulations; violent effervescence; moderately alkaline.

The A horizon ranges from 8 to 14 inches in thickness. It is dominantly silt loam, but in places it is silty clay loam. The B horizon ranges from 15 to 22 inches in thickness. It ranges from dark grayish brown and grayish brown to pale brown. Depth to lime ranges from 20 to 36 inches. Some profiles have an accumulation of lime below the B3 horizon.

The Holdrege soil in mapping unit HnD2 has a thinner solum and a lighter colored A horizon than is defined as within the range for the series. These differences do not alter the usefulness or behavior of this soil.

Holdrege soils are near Fillmore, Butler, Detroit, Hastings, Nuckolls, Coly, and Uly soils. They have less clay in the B horizon than Fillmore, Butler, Detroit, and Hastings soils. They have more clay in the B horizon than the Nuckolls and Uly soils. Holdrege soils have a B horizon, which is lacking in the Coly soils. They have lime that is leached to a lower depth than in Uly or Coly soils.

Hh—Holdrege silt loam, 0 to 1 percent slopes. This deep, silty soil is on loess uplands. The areas range from 10 to 1,000 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of Hall silt loam and of Butler, Detroit, and Hastings soils.

Lack of sufficient moisture is the principal limitation when this soil is dryfarmed. Soil blowing is a hazard when the surface is not protected by plant cover. Runoff is slow.

This is one of the best soils in Franklin County for crops. Nearly all the acreage is cultivated. A large part is irrigated from deep wells. The major crops are corn, grain sorghum, wheat, and alfalfa. Capability units IIc–1, dryland, and I–4, irrigated; Silty range site; windbreak suitability group 4.

HhB—Holdrege silt loam, 1 to 3 percent slopes. This is a deep, silty soil on uplands. The areas range from 5 to 800 acres in size. The profile of this soil is similar to the one described as representative of the Holdrege series, but it is slightly thinner.

Included with this soil in mapping were small areas of soils that have an eroded surface layer. Also included were small areas of nearly level Holdrege silt loam and Hastings silt loam.

Water erosion and soil blowing are hazards on this soil. When the soil is dryfarmed, low rainfall is commonly a limitation. Some land leveling is needed for gravity irrigation. Runoff is medium.

Most of the acreage of this soil is cultivated. Corn, grain sorghum, wheat, and alfalfa are the main crops grown. Both dryland and irrigated management are used. A few areas are in native grasses. Capability units IIe–1, dryland, and IIe–4, irrigated; Silty range site; windbreak suitability group 4.

HhC—Holdrege silt loam, 3 to 6 percent slopes. This soil is mainly on hillsides and ridgetops of the loess uplands. It is also adjacent to depressions and basins. Areas range from 5 to 80 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner.

Included with this soil in mapping were small areas of strongly sloping Holdrege silt loam and Uly silt loam.

Water erosion and soil blowing are the main hazards in cultivated areas. Runoff is medium.

Most of the acreage of this soil is in native grasses. A small acreage is cultivated. Capability units IIIe–1, dryland, and IIIe–4, irrigated; Silty range site; windbreak suitability group 4.

HhD—Holdrege silt loam, 6 to 9 percent slopes. This soil is on ridgetops and side slopes of the loess uplands. The areas range from 5 to 60 acres in size. This soil has a profile similar to the one described as representative of the series, but the combined thickness of the surface layer and subsoil is about 8 inches less.

Included with this soil in mapping were small areas of gently sloping Holdrege silt loam and Uly silt loam.

Water erosion is a severe hazard and soil blowing is likely unless the surface is protected by plant cover. Runoff is medium.

Most of the acreage of this soil is in native grasses. A small acreage is cultivated. Capability units IVe–1, dryland, and IVe–4, irrigated; Silty range site; windbreak suitability group 4.

HnD2—Holdrege and Uly soils, 3 to 9 percent slopes, eroded. These soils are on ridgetops and hillsides on loess uplands. Areas range from 5 to 300 acres in size.

This mapping unit is about 60 percent Holdrege silt loam and 30 percent Uly silt loam. Proportions of these soils vary from area to area. Most areas have a greater percentage of the Holdrege soil than of the Uly soil, and a few areas have only one of these soils. The Uly soil is on the ridgetops and the upper part of hillsides. The Holdrege soil is on the lower part of the hillsides below the Uly soils.

The Holdrege and Uly soils have profiles similar to the ones described as representative of their respective series, but the surface layer and subsoil are slightly thinner and lime is nearer the surface.

Included with these soils in mapping were small areas of severely eroded soils that are light colored on the surface because erosion has removed most of the original dark-colored surface layer. Tillage has mixed the remaining part of the surface layer with material from the subsoil. Also included are small areas of uneroded Holdrege silt loam and eroded Nuckolls soils.

Water erosion is the main hazard. Soil blowing is also a hazard if the surface layer is not adequately protected. Areas that are light colored have low fertility. Workability is generally easy, but small gullies are common in places. Runoff is medium.

Nearly all the acreage of this mapping unit is cultivated. Grain sorghum and wheat are the principal crops, but corn and alfalfa are also grown. Only a few areas are irrigated. Much of the acreage has been reseeded to native grasses. Capability units IVe–8, dryland, and IVe–3, irrigated; Silty range site; windbreak suitability group 4.

Hord Series

The Hord series consists of deep, nearly level and very gently sloping, well drained soils on stream terraces. These soils formed in loess and alluvium derived from loess.

In a representative profile the surface layer is dark grayish brown, very friable and friable silt loam 16 inches thick. The subsoil is about 25 inches thick. It is dark grayish brown, friable heavy silt loam in the upper part and pale brown, very friable silt loam in the lower part. The underlying material, at a depth of 41 inches, is pale brown silt loam.

Hord soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. These soils release moisture readily to plants.

Hord soils are suited to cultivated crops under both dryland and irrigation management. They are suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Hord silt loam, terrace, 0 to 1 percent slopes, in a cultivated field, 450 feet north and 300 feet east of the southwest corner of sec. 35, T. 2 N., R. 15 W.:

Ap—0 to 6 inches, dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine crumb structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A12—6 to 16 inches, dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; few fine pores; neutral; clear smooth boundary.

B2—16 to 29 inches, dark grayish brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard; friable; few fine pores; neutral; gradual smooth boundary.

B3—29 to 41 inches, pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable; few fine pores; few very small white lime accumulations, mildly alkaline; clear smooth boundary.

C—41 to 60 inches, pale brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; many fine soft white lime accumulations; dark-colored layer at depth of 46 to 51 inches; violent effervescence; moderately alkaline.

The solum ranges from 35 to 55 inches in thickness. The A horizon ranges from 12 to 24 inches in thickness. It is dominantly silt loam, but in areas it is loam. It is slightly acid or neutral in reaction. The B2 horizon is silt loam or light silty clay loam. Depth to lime ranges from 35 to 46 inches.

Hord soils are near Hall soils. They have less clay in the B2 horizon than Hall soils.

Hr—Hord silt loam, terrace, 0 to 1 percent slopes. This deep, silty soil is on stream terraces. It has the profile described as representative of the series. Areas range from 5 to 400 acres in size.

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

When this soil is dryfarmed, a shortage of rainfall is the main limitation. Soil blowing is a hazard where the surface is not protected by plant cover. Runoff is slow.

This is one of the best soils in Franklin County for crops. Almost all of the acreage is cultivated; a large part is irrigated. Corn, grain sorghum, alfalfa, and wheat are the principal crops. Capability units IIc–1, dryland, and I–6, irrigated; Silty Lowland range site; windbreak suitability group 1.

HrB—Hord silt loam, terrace, 1 to 3 percent slopes.

This silty soil is on stream terraces. It has a profile similar to the one described as representative of the series, but the surface layer and subsoil are slightly thinner. In places, water erosion and soil blowing have removed some of the dark-colored surface layer. Areas range from 5 to 160 acres in size.

Included with this soil in mapping were small areas of soils in which erosion has removed nearly all of the original surface layer and the dark grayish brown subsoil is exposed at the surface.

Water erosion is the major hazard on this soil. Soil blowing is a hazard if the surface layer is not protected. This soil is easily worked. Runoff is slow.

Most of the acreage of this soil is cultivated. Corn, grain sorghum, wheat, and alfalfa are the main crops. Some areas are irrigated. Capability units IIe–1, dryland, and IIe–6, irrigated; Silty Lowland range site; windbreak suitability group 1.

Inavale Series

The Inavale series consists of deep, nearly level and very gently sloping, excessively drained soils on bottom lands. These soils formed in sandy and loamy alluvium. They have a seasonal high water table that is at a depth of 5 to 10 feet in most years, but in late summer the water table may recede to a depth of about 15 feet.

In a representative profile the surface layer is grayish brown, very friable loamy sand 8 inches thick. Beneath this is a transition layer of light brownish gray loamy sand that is about 16 inches thick. Beneath this to a depth of 60 inches, the underlying material is light gray sand.

Inavale soils have rapid permeability and low available water capacity. The organic-matter content and natural fertility are low. These soils release moisture readily to plants.

Inavale soils are suited to cultivated crops. They are well suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Inavale loamy sand, 0 to 3 percent slopes, in native grasses, 3,432 feet south and 1,584 feet east of the northwest corner of sec. 2, T. 1 N., R. 15 W.:

A—0 to 8 inches, grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak coarse granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

AC—8 to 24 inches, light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak coarse granular structure; soft very friable; stratified with thin lenses of very fine sand, fine sand, and coarse sand; mildly alkaline; diffuse smooth boundary.

C—24 to 60 inches, light gray (10YR 7/2) sand, grayish brown (10YR 5/2) moist; single grained; loose; stratified with thin lenses of very fine sand, fine sand, and coarse sand; moderately alkaline.

The A horizon ranges from 4 to 14 inches in thickness. It is dominantly loamy sand, but in places it is fine sandy loam, sandy loam, and fine sand. It ranges from neutral to moderately alkaline in reaction. The AC horizon is commonly loamy sand but ranges to fine sand or sand in the lower part. The AC and C horizons are commonly stratified with thin layers of very fine sand, loamy very fine sand, and coarse sand.

Inavale soils are near Munjor, McCook, and Wann soils. They have more sand throughout the profile than Munjor and McCook soils. They have more sand in the upper part of the C horizon than Wann soils and have a lower water table.

Ig—Inavale loamy sand, 0 to 3 percent slopes. This soil is on bottom lands. It is hummocky in places. It has the profile described as representative of the series. Areas range from 5 to 80 acres in size.

Included with this soil in mapping were areas of a soil that has a surface layer of fine sand and small areas of Inavale fine sandy loam and Munjor loamy fine sand.

Soil blowing is a hazard where the surface is not protected by plant cover. Where this soil is in crops, it is droughty because of low available water capacity. Runoff is very slow; the water enters the soil about as rapidly as it falls.

Cultivated crops are grown on this soil under both dryland and irrigation management. Wheat and grain sorghum are the main dryfarmed crops. Corn and grain sorghum are irrigated, and alfalfa is irrigated in a few areas. A few areas are in native grasses. Capability units IVe–5, dryland, and IIIe–11, irrigated; Sandy Lowland range site; windbreak suitability group 3.

In—Inavale fine sandy loam, 0 to 3 percent slopes. This deep soil is on bottom lands. It is hummocky in some areas. It has a profile similar to the one described as representative of the series, but it has a surface layer of fine sandy loam. Areas range from 5 to 60 acres in size.

Included with this soil in mapping were a few small areas of Munjor fine sandy loam, McCook fine sandy loam, and Inavale loamy sand.

Soil blowing is the main hazard. Where dryfarmed, this soil is droughty because of low available water capacity. Runoff is slow; most water enters the soil rapidly.

Most of the acreage of this soil is cultivated and irrigated. Wheat and grain sorghum are dryfarmed. Corn, grain sorghum, and alfalfa are irrigated. A few areas are in native grasses. Capability units IIIe–3, dryland, and IIIe–11, irrigated; Sandy Lowland range site; windbreak suitability group 3.

Kenesaw Series

The Kenesaw series consists of deep, nearly level to gently sloping, well drained, silty soils on uplands. These soils formed in loess.

In a representative profile the surface layer is grayish brown, very friable silt loam 8 inches thick. The subsoil is light brownish gray, very friable silt loam 12 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches.

Kenesaw soils have high available water capacity and moderate permeability. The organic-matter content is moderately low, and natural fertility is high. These soils release moisture readily to plants.

Kenesaw soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Kenesaw silt loam, 0 to 1 percent slopes, in a cultivated field, 528 feet east and 75 feet north of the southwest corner of sec. 8, T. 4 N., R. 14 W.:

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

B2—8 to 20 inches, light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable; neutral; gradual smooth boundary.

C—20 to 60 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; few lime concretions and mycelium-like threads; violent effervescence; mildly alkaline.

The solum ranges from 14 to 26 inches in thickness. The A horizon ranges from 8 to 10 inches in thickness. Depth to lime ranges from 15 to 50 inches. The C horizon has strata of fine sandy loam in the lower part of the profile in some places.

Kenesaw soils are near Hersh, Coly, Holdrege, and Uly soils. They have more silt and clay and less sand throughout the profile than Hersh and Valentine soils. They are deeper to lime than Coly soils and shallower to lime than Holdrege soils. They have less clay in the subsoil than Holdrege or Uly soils.

Kn—Kenesaw silt loam, 0 to 1 percent slopes. This soil is on loess uplands. It is very slightly hummocky, and its surface drainage is not well defined. It has the profile described as representative of the series. Areas range from 5 to 500 acres in size.

Included with this soil in mapping were a few small areas of Holdrege silt loam.

Lack of sufficient moisture is the major limitation where this soil is dryfarmed. Soil blowing is a hazard where the surface is not protected. Maintaining fertility is an important concern in irrigation management. Runoff is slow.

Nearly all the acreage of this soil is cultivated. Some areas are irrigated. Corn, alfalfa, grain sorghum, and wheat are the principal crops. Capability units IIc–1, dryland, and I–6, irrigated; Silty range site; windbreak suitability group 4.

KnB—Kenesaw silt loam, 1 to 3 percent slopes. This silty soil is on loess uplands. It is slightly hummocky, and its surface drainage is not well defined. The surface layer of this soil is slightly thinner than the one described as representative of the series. Areas range from 5 to 300 acres in size.

Included with this soil in mapping were small areas of Holdrege silt loam and Kenesaw silt loam, 3 to 6 percent slopes.

Water erosion is the main hazard on this soil. Soil blowing is a hazard where the surface is not protected. Runoff is slow.

Most of the acreage of this soil is cultivated. A small acreage is irrigated. The major crops grown are wheat, grain sorghum, alfalfa, and corn. Capability units IIe–1, dryland, and IIe–6, irrigated; Silty range site; windbreak suitability group 4.

KnC—Kenesaw silt loam, 3 to 6 percent slopes. This deep, silty soil is on the loess uplands. It is hummocky, and its surface drainage is not well defined. It has a profile similar to the one described as representative of the series, but the surface layer and transition layer are thinner. Areas range from 5 to 160 acres in size.

Included with this soil in mapping were small areas of Hersh fine sandy loam.

Water erosion and soil blowing are hazards. Selecting the proper methods of applying water and maintaining fertility is an important concern in management where this soil is irrigated. Runoff is medium.

Most of the acreage of this soil is cultivated. Wheat and grain sorghum are the principal crops, but corn and alfalfa are also grown. Only a few acres are irrigated. A few areas are in native grasses. Capability units IIIe–1, dryland, and IIIe–6, irrigated; Silty range site; windbreak suitability group 4.

Kipson Series

The Kipson series consists of shallow, moderately steep and steep, somewhat excessively drained soils on uplands. These soils formed in loamy material weathered from interbedded chalky shale and soft limestone.

In a representative profile the surface layer is dark gray, friable silt loam 7 inches thick. Beneath this is a transition layer of light brownish gray silt loam that contains a few, weathered, soft limestone chips. The underlying material is at a depth of 13 inches. The upper 6 inches is very pale brown silt loam containing many soft limestone chips. Beneath this is interbedded, chalky shale and soft, limestone bedrock. Lime is throughout the profile.

Kipson soils have moderate permeability and low available water capacity. The organic-matter content is moderately low, and natural fertility is low. Kipson soils release moisture readily to plants.

Kipson soils are suited to grasses, to habitat for wildlife, and to recreational uses. They are not suited to the common cultivated crops, because they are too shallow and too steep. They are not suited to planting of trees or shrubs in windbreaks.

Representative profile of Kipson silt loam in an area of Kipson complex, 9 to 30 percent slopes, in native grasses, 792 feet west and 1,056 feet south of the northeast corner of sec. 24, T. 1 N., R. 14 W.:

A—0 to 7 inches, dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, friable; weathered soft limestone chips make up about 3 percent of the soil mass; violent effervescence; moderately alkaline; clear smooth boundary.

AC—7 to 13 inches, light brownish gray (10YR 6/2) silt loam, dark grayish-brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable; weathered soft, limestone chips make up about 10 percent of the soil mass; violent effervescence; strongly alkaline; clear smooth boundary.

C1—13 to 19 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable; limestone chips and fragments make up 25 to 35 percent of soil mass and increase as depth increases; violent effervescence; strongly alkaline; clear wavy boundary.

C2—19 to 24 inches, very pale brown (10YR 8/4) interbedded chalky shale and soft limestone.

The A horizon ranges from 6 to 12 inches in thickness. Depth to unweathered bedrock ranges from 10 to 20 inches.

Kipson soils are near Canyon and Campus soils. They are shallower than Canyon soils. They formed in chalky shale and soft limestone, whereas Canyon soils formed in limy sandstone.

KsF—Kipson complex, 9 to 30 percent slopes. This complex is on shoulders and crests of upland ridges and on side slopes that border intermittent drainageways. It consists of 60 to 80 percent Kipson silt loam on ridges and upper parts of side slopes; 15 to 25 percent chalk outcrop and very shallow soils over chalk on side slopes; and 0 to 10 percent Broken alluvial land at the lowest elevations. Areas range from 15 to 900 acres in size.

The shallow depth to bedrock is the major limitation. Water erosion and soil blowing are hazards where the surface is not protected by plants. Runoff is medium.

Areas of this complex are in native grasses and are used mainly for livestock grazing and as habitat for wildlife. Capability unit VIs–4, dryland; Shallow Limy range site; windbreak suitability group 10.

Marsh

Ma—Marsh. This land type is in wet depressions on bottom lands in the Republican River valley. It is variable in texture in the upper part, but it generally has mixed sand and gravel at a depth of 3 to 5 feet. In most places 1 inch to 3 inches of brownish, fibrous, partially decomposed plants is on the surface. Areas range from 10 to 60 acres in size.

Included with this land type in mapping were a few small areas of Riverwash.

Marsh is very poorly drained. Permeability ranges from very slow to moderate. Water is near or on the surface during most of the year.

Vegetation in areas of Marsh consists mostly of cattails, rushes, and sedges. Areas are too wet for the common cultivated crops and for most grasses and trees. In places, reedgrass, canarygrass, and willows grow on the edges of Marsh. Some small areas lack vegetation. Marsh is better suited to habitat for certain kinds of wetland wildlife than to most other uses. Capability unit VIIIw–7, dryland; windbreak suitability group 10.

McCook Series

The McCook series consists of deep, nearly level, well drained soils on bottom lands. These soils formed in silty and loamy alluvium (fig. 11). They have a seasonal high water table that is at a depth of 5 to 8 feet in most years, but in late summer the water table may fall to a depth of about 15 feet.

In a representative profile the surface layer is grayish brown and gray, very friable silt loam 11 inches thick. Beneath this is a transition layer of light brownish gray silt loam 10 inches thick. The light gray underlying material is between depths of 21 and 60 inches. It is very fine sandy loam in the upper part and sandy loam in the lower part.

McCook soils have high available water capacity and moderate permeability. Natural fertility is high, and the organic-matter content is moderately low. These soils release moisture readily to plants. They contain lime throughout the profile.

McCook soils are suited to all commonly grown cultivated crops under both dryland and irrigation management. They are also suited to grasses, to trees and shrubs for windbreaks, to habitat for wildlife, and to recreational uses.

Representative profile of McCook silt loam, 0 to 2 percent slopes, in a cultivated field, 2,904 feet west and 264 feet north of the southeast corner of sec. 2, T. 1 N., R. 15 W.:

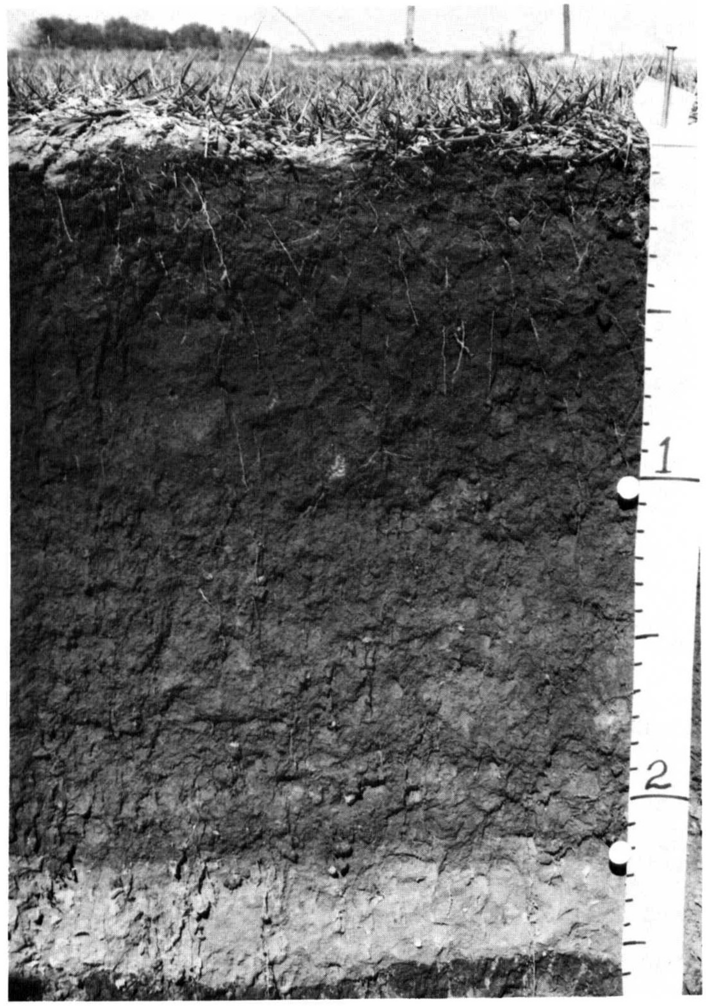

Figure 11.—**Profile of a McCook silt loam.**

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

A12—5 to 11 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak coarse prismatic structure parting to weak medium and fine granular; slightly hard, very friable; many worm castings; strong effervescence; mildly alkaline; clear smooth boundary.

AC—11 to 21 inches, light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; soft, very friable; many worm castings; violent effervescence; moderately alkaline; clear smooth boundary.

C1—21 to 49 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; few fine faint yellow (10YR 7/6) moist mottles; massive; soft very friable; moderately alkaline; violent effervescence; abrupt smooth boundary.

C2—49 to 60 inches, light gray (10YR 7/2) sandy loam, grayish brown (10YR 5/2) moist; common fine distinct reddish-yellow (7.5YR 6/6, moist) mottles; massive; soft very friable; violent effervescence; moderately alkaline.

The A horizon ranges from 7 to 19 inches in thickness. It is fine sandy loam or silt loam that ranges from dark gray to grayish brown in color. The AC horizon ranges from 10 to 20 inches in thickness.

McCook soils are near Roxbury, Munjor, Inavale, Hobbs, and Gibbon soils. They have a higher percentage of sand in the C horizon than Roxbury and Hobbs soils, and the dark colored part of their surface layer is not so deep as in those soils. They lack the stratification typical of Hobbs soils. They have less sand between depths of 10 to 40 inches than Munjor or Inavale soils. They have more sand in the upper part of the C horizon and have a lower water table than Gibbon soils.

Mb—McCook fine sandy loam, 0 to 2 percent slopes. This soil is on bottom lands. It has a profile similar to the one described as representative of the series, but the surface layer is fine sandy loam. Areas range from 5 to 80 acres in size.

Included with this soil in mapping were a few small areas of McCook silt loam and Munjor fine sandy loam.

Soil blowing is a moderate hazard if the surface is not protected. Maintaining balanced fertility is a concern in irrigation management. Excess lime in the soil tends to make some of the phosphorus unavailable to plants. This soil is easy to work. Runoff is slow.

Most of the acreage of this soil is cultivated, and some is irrigated. Corn, grain sorghum, and alfalfa are the main crops, but wheat is also grown. A few areas are in native grasses. Capability units IIe-3, dryland, and IIe-5, irrigated; Silty Lowland range site; windbreak suitability group 3.

Mc—McCook silt loam, 0 to 2 percent slopes. This soil is in bottom land areas that are rarely flooded. It has the profile described as representative of the series. Areas range from 5 to 300 acres in size.

Included with this soil in mapping were a few small areas of McCook fine sandy loam and of Roxbury silt loam.

This soil has few limitations restricting its use. It is easy to work and is excellent for crops. Maintaining and balancing fertility are concerns in management, because lime in the soil tends to make some of the phosphorus unavailable to plants. Soil blowing is a hazard if the surface is unprotected. Runoff is slow.

Almost all the acreage of this soil is cultivated. Both dryland and irrigation management are common. Corn, grain sorghum, alfalfa, and wheat are the major crops. Capability units I-1, dryland, and I-6 irrigated; Silty Lowland range site; windbreak suitability group 1.

Meadin Series

The Meadin series consists of moderately steep and steep, excessively drained soils on uplands. These soils are shallow over mixed sand and gravel (fig. 12).

In a representative profile the surface layer is grayish brown, very friable loam 8 inches thick. Beneath this is a transition layer that is grayish brown, gravelly sandy loam 6 inches thick. The underlying material, to a depth of 60 inches, is light brownish gray and white coarse sand and gravel.

Meadin soils have very rapid permeability in the sand and gravel layers. Available water capacity is low. The organic-matter content and natural fertility are low. These soils release moisture readily to plants.

Meadin soils are a source of sand and gravel. They are not suited to the commonly grown crops, because of shallowness and slope, and are not suited to plantings of trees and shrubs. These soils are suited to native grasses, to habitat for wildlife, and to recreational uses.

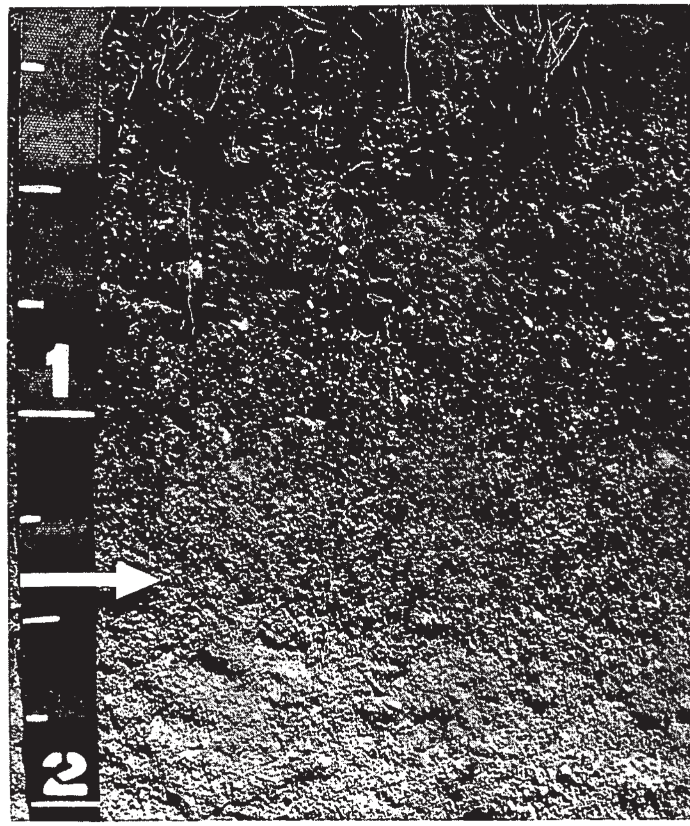

Figure 12.—**Profile of a Meadin loam.**

Meadin soils in Franklin County are mapped only in a complex with Nuckolls soils.

Representative profile of Meadin loam in an area of Nuckolls and Meadin soils, 9 to 30 percent slopes, in native grasses, 3,168 feet south and 100 feet east of the northwest corner of sec. 28, T. 2 N., R. 13 W.:

A—0 to 8 inches, grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable; neutral; clear smooth boundary.

AC—8 to 14 inches, grayish brown (10YR 5/2) gravelly sandy loam; very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; soft, very friable; neutral; gradual smooth boundary.

IIC1—14 to 38 inches, light brownish gray (10YR 6/2) mixed coarse sand and gravel, grayish brown (10YR 5/2) moist; single grained; loose; neutral; gradual wavy boundary.

IIC2—38 to 60 inches, white (10YR 8/2) mixed coarse sand and gravel, light gray (10YR 7/2) moist; single grained; loose; neutral.

The A horizon ranges from 6 to 12 inches in thickness, and the AC horizon ranges from 2 to 6 inches in thickness. The A horizon is commonly loam, but in some areas it is sandy loam, coarse sandy loam, or loamy sand.

Meadin soils are near Nuckolls, Hersh, and Valentine soils. They are not so deep as Nuckolls soils and are over mixed sand and gravel, whereas Nuckolls soils are in silty material. They have mixed coarse sand and gravel in the C horizon, whereas Hersh and Valentine soils have no gravel in the C horizon.

Munjor Series

The Munjor series consists of deep, nearly level, well drained soils on bottom lands. These soils formed in calcareous loamy and sandy alluvium. They have a seasonal high water table at a depth of 6 to 8 feet in most years, but in late summer the water table may fall to a depth of about 15 feet.

In a representative profile the surface layer is light brownish-gray, very friable fine sandy loam 9 inches thick. The underlying material is light gray, mottled sandy loam in the upper part and is very pale brown, mottled coarse and medium sand in the lower part. The profile is limy throughout.

Munjor soils have moderately rapid permeability and moderate available water capacity. The organic-matter content is low, and natural fertility is medium. The lime in these soils lowers the availability of phosphorus to plants. These soils release moisture readily to plants.

Munjor soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Munjor fine sandy loam, 0 to 2 percent slopes, in a cultivated field, 1,584 feet north and 950 feet east of the southwest corner of sec. 36, T. 2 N., R. 15 W.:

A—0 to 9 inches, light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—9 to 46 inches, light gray (10YR 7/2) sandy loam, grayish brown (10YR 5/2) moist; common medium faint reddish brown (5YR 5/3) moist mottles below a depth of 22 inches; massive; soft, very friable; thin stratified layers that are finer in texture and coarser in texture than the matrix; slight effervescence; moderately alkaline; gradual smooth boundary.

C2—46 to 60 inches, very pale brown (10YR 7/3) coarse and medium sand, pale brown (10YR 6/3) moist; common medium faint reddish brown (5YR 5/3, moist) mottles; single grained; loose; violent effervescence; moderately alkaline.

The A horizon ranges from 3 to 15 inches in thickness. It is fine sandy loam or loamy fine sand that ranges from grayish brown to very pale brown in color. Free carbonates are at a depth of 0 to 10 inches.

Munjor soils are near Roxbury, Inavale, McCook, Hobbs, and Wann soils. They have more sand in the C horizon than Roxbury, McCook, and Hobbs soils. They have less sand in the upper part of the C horizon than Inavale soils. They have a lower water table than Wann soils and are not so dark-colored in the surface layer.

Mn—Munjor loamy fine sand, 0 to 2 percent slopes. This deep soil is on bottom lands. It has a profile similar to the one described as representative of the series, but the surface layer is loamy fine sand. Areas range from 5 to 400 acres in size.

Included with this soil in mapping were a few small areas of a soil that has a surface layer of fine sandy loam and a few areas of Inavale loamy sand.

The hazard of soil blowing is severe if the surface is not adequately protected. Where dryfarmed, this soil is droughty. Maintaining and balancing crop nutrients are important concerns in management, particularly where the soil is irrigated. Runoff is slow, and water enters the soil rapidly. This soil is easy to work.

Most of the acreage of this soil is cultivated. A few areas are irrigated, and a few areas are in native grasses. Capability units IIIe-5, dryland, and IIIe-10, irrigated; Sandy Lowland range site; windbreak suitability group 3.

Mu—Munjor fine sandy loam, 0 to 2 percent slopes. This deep soil is on bottom lands. It has the profile described as representative of the series. Areas range from 5 to 1,000 acres in size.

Included with this soil in mapping were a few small areas of Inavale fine sandy loam and McCook fine sandy loam.

The hazard of soil blowing is moderate. This soil is droughty where dryfarmed because available water capacity is moderate. Maintaining and balancing plant nutrients are important concerns in management, particularly where the soil is irrigated. This soil is easy to work and can be tilled relatively soon after rains. Runoff is slow.

Most of the acreage of this soil is cultivated. Both dryland and irrigation management are common. Corn, grain sorghum, alfalfa, and wheat are the major crops. A few areas are in native grasses and are used for grazing. Capability units IIe-3, dryland, and IIe-8, irrigated; Sandy Lowland range site; windbreak suitability group 3.

Nuckolls Series

The Nuckolls series consists of deep, gently sloping to steep well drained to somewhat excessively drained soils on uplands.

In a representative profile the surface layer is grayish brown, friable silt loam 10 inches thick. The subsoil is friable silt loam about 19 inches thick. It is pale brown in the upper part and light yellowish brown in the lower part. The underlying material is at a depth of 29 inches. It is light-brown silt loam.

Nuckolls soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is medium. These soils release moisture readily to plants.

Nuckolls soils are suited to cultivated crops under both dryland and irrigation management if slopes are less than 9 percent. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Nuckolls silt loam in an area of Nuckolls-Hobbs complex, 9 to 30 percent slopes, in native grasses, 2,376 feet west and 528 feet south of the northeast corner of sec. 28, T. 2 N., R. 15 W.:

A—0 to 10 inches, grayish brown (10YR 5/2) silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

B1—10 to 13 inches, pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable; numerous worm castings; neutral; gradual smooth boundary.

B2—13 to 24 inches, pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; strong medium subangular blocky structure; slightly hard, friable; numerous worm castings; neutral; gradual smooth boundary.

B3—24 to 29 inches, light yellowish brown (10YR 6/4) silt loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

C—29 to 60 inches, light brown (7.5YR 6/4) silt loam, brown (7.5YR 5/4) moist; weak coarse prismatic structure; slightly hard, very friable; mildly alkaline.

The A horizon ranges from 7 to 14 inches in thickness. The B horizon ranges from 13 to 26 inches in thickness and from grayish brown to pale brown in color. Depth to lime ranges from 20 to 36 inches. Some profiles have a Cca horizon beneath the B3 horizon.

The Nuckolls soil in mapping unit NoD2 has a thinner solum and a lighter colored A horizon than is defined as within the range for the series. These differences, however, do not alter the usefulness or behavior of the soil.

Nuckolls soils are near Holdrege, Uly, Coly, and Meadin soils. They have less clay in the B horizon than Holdrege soils. They have lime leached deeper in the profile than Uly soils. They formed in material of the Loveland Formation, whereas Coly, Uly, and Holdrege soils formed in Peoria loess. They have a B horizon, which Coly soils lack. They are deeper than Meadin soils and are over silty material, whereas Meadin soils are over mixed sand and gravel.

NhF—Nuckolls-Hobbs complex, 9 to 30 percent slopes. This complex is about 50 to 70 percent Nuckolls silt loam, 25 to 35 percent Hobbs silt loam, and 10 percent other soils. The moderately steep and steep Nuckolls soil is on upland side slopes, and the nearly level Hobbs soil is on the narrow bottom lands of intermittent drainageways. Areas range from 80 to 800 acres in size.

Included with these soils in mapping were small areas of a Nuckolls soil that has more clay in the subsoil than is typical of the Nuckolls soil in this complex. Also included were small areas of Campus, Coly, Meadin, and Uly soils and of Rough broken land, loess.

Erosion is a very serious hazard on the Nuckolls soil, and occasional flooding is the main hazard on the Hobbs soil.

Almost all the acreage of this complex is in native grasses. The Nuckolls soil is too steep for common cultivated crops. A few of the larger areas of the Hobbs soil are cultivated, and a few are irrigated. Capability unit VIe–1, dryland; Nuckolls soil in Silty range site and Hobbs soil in Silty Overflow range site; windbreak suitability group 10.

NmC—Nuckolls and Holdrege silt loams, 3 to 6 percent slopes. These soils are on ridgetops and side slopes bordering upland drainageways. The areas range from 5 to 40 acres in size. Most areas contain both soils, but the proportions of these soils vary from area to area. Some areas have only one major soil, either the Nuckolls soil or the Holdrege soil. The Nuckolls soil is generally below the Holdrege soil on the landscape, but in places it is on ridgetops.

The Nuckolls and Holdrege soils have profiles similar to the ones described as representative of their respective series, but the surface layer and subsoil are slightly thinner and lime is nearer the surface.

Included with these soils in mapping were small areas of a Nuckolls soil that has more clay in the subsoil than is typical of the Nuckolls soil in this undifferentiated group.

Water erosion is a serious hazard if these soils are cultivated. Soil blowing can be a hazard if the surface layer is not adequately protected. Runoff is medium.

Nearly all the acreage of these soils is in native grasses. Only a few areas are cultivated, and these are chiefly in wheat and grain sorghum. Capability units IIIe–1, dryland, and IIIe–4, irrigated; Silty range site; windbreak suitability group 4.

NmD—Nuckolls and Holdrege silt loams, 6 to 9 percent slopes. These soils are on ridgetops and side slopes that border intermittent upland drainageways. Areas range from 5 to 40 acres in size. Most areas contain both soils, but the proportions of the soils vary from one area to another. Some areas have only one major soil, either the Nuckolls soil or the Holdrege soil. The Nuckolls soil is generally below the Holdrege soil on the landscape, but in places it is on ridgetops.

The profile of the Nuckolls and Holdrege soils is similar to the ones described as representative of their respective series, but the surface layer and subsoil are slightly thinner and lime is nearer the surface.

Included with these soils in mapping were small areas of a Nuckolls soil that has more clay in the subsoil than is typical of the Nuckolls soil in this undifferentiated group.

Water erosion is a very severe hazard where these soils are cultivated. Soil blowing is a hazard if the surface layer is not adequately protected. Runoff is medium.

Most of the acreage of these soils is in native grasses. A few areas are cultivated. Wheat and grain sorghum are the principal crops. Capability units IVe–1, dryland, and IVe–4, irrigated; Silty range site; windbreak suitability group 4.

NoD2—Nuckolls and Holdrege soils, 3 to 9 percent slopes, eroded. These soils are on ridgetops and side slopes that border drainageways. The areas range from 5 to 200 acres in size. Most areas contain both Nuckolls and Holdrege soils, and proportions of these soils vary from one area to another. A few areas contain only one major soil. The Nuckolls soil generally is at a lower elevation on the landscape than the Holdrege soil, but in places it is on ridgetops. The surface layer in most areas is silt loam, but silty clay loam is common.

These soils have profiles similar to the ones described as representative of their respective series, but the surface layer and subsoil are slightly thinner, reaction of the surface layer is neutral or slightly acid, and lime is nearer the surface.

Included with these soils in mapping were small areas of Nuckolls and Holdrege soils that are severely eroded and that have a lighter colored surface layer than that described as representative of their respective series. This is because erosion has removed most of the original dark-colored surface layer. Tillage has mixed the remaining part of the surface layer with material from the subsoil. Also included are small areas of Nuckolls, Holdrege, and Uly soils that have 3 to 6 percent slopes, and a few areas of Nuckolls soils that have more clay in the subsoil than is typical of the Nuckolls soil in this undifferentiated group.

Water erosion is a severe hazard where these soils are cultivated. Soil blowing is a hazard if the surface layer is not adequately protected. Areas that are lightest in color have low fertility and are commonly limy at the surface. Organic matter content is low. Workability is poor, because small gullies are common. Runoff is medium.

Nearly all the acreage of these soils is cultivated. Grain sorghum and wheat are the principal crops, but corn and alfalfa are also grown. Only a few areas are irrigated. Part of the acreage has been reseeded to native grasses. Capability units IVe–8, dryland, and IVe–3, irrigated; Silty range site; windbreak suitability group 4.

NpD—Nuckolls and Meadin soils, 9 to 30 percent slopes. These soils are in areas that border intermittent upland drainageways. Areas range from 10 acres to about 400 acres in size.

The surface layer of the Nuckolls soil is mainly silt loam, and that of the Meadin soil is most commonly loam. Both soils are in most of the areas, but the proportions of one soil to the other vary from one area to another. A few areas contain only one soil, either Nuckolls or Meadin soil. The Nuckolls soils are in higher positions on the landscape than Meadin soils.

These soils have profiles similar to the ones described as representative of their respective series, but the profile of the Meadin soil is slightly browner and in a few areas the Nuckolls soil has more clay in the subsoil.

Included with these soils in mapping were small areas of Coly silt loam and Uly silt loam on some of the ridgetops; Hobbs silt loam in narrow drainageways; Hersh and Valentine soils; and Rough broken land, loess.

Erosion is a very severe hazard. Soil blowing is a limitation where the surface layer is not adequately protected. These soils are too steep for the common cultivated crops. The Meadin soils are droughty because of low available water capacity. Runoff is rapid.

Almost all the acreage of these soils is in native grasses. Capability unit VIe–1, dryland; Nuckolls soil in Silty range site and Meadin soil in Shallow to Gravel range site; windbreak suitability group 10.

Riverwash

Ra—Riverwash (0 to 3 percent slopes). This land type is on sand bars, sand flats, and small islands on bottom lands within and adjacent to channels of the Republican River. The material is stratified sand and gravel and thin strata of silt loam and very fine sandy loam. Areas are generally 1 foot to 3 feet higher in elevation than the level of water at normal streamflow. They range from 10 to 160 acres in size.

Flooding is common each spring during periods of high water when there is much shifting and reworking of the material. The vegetation consists mainly of a few willows and cottonwoods that help to stabilize the sand.

Riverwash has little or no value for farming. It is suitable habitat for wildlife. The sand and gravel are used as material for building roads and for other engineering purposes. Capability unit VIIIw–7, dryland; windbreak suitability group 10.

Rough Broken Land, Loess

RbG—Rough broken land, loess, 20 to 60 percent slopes. This land type is on the sides of very steep canyons in the loess upland (fig. 13). It consists of gray, calcareous silt loam and loam material. It is steep and very steep and commonly has "catsteps". Soil formation is limited to a thin, slightly darkened surface layer. In some places on the lower elevations of canyon sides, brownish or reddish silty material is exposed at the surface. Areas range from 10 to 320 acres in size.

Included with this land type in mapping were a few small areas of Coly, Nuckolls, and Uly soils. This land differs from the soils mainly in having a thinner, lighter colored surface layer and in having steeper slopes.

Erosion is a very severe hazard. Runoff is very rapid. Organic-matter content is very low, and natural fertility is low.

Areas of this land type are used for grazing. They are too steep for the common cultivated crops. They provide food and cover for wildlife. Planting of trees generally is not practical. Capability unit VIIe–9, dryland; Thin Loess range site; windbreak suitability group 10.

Rough Stony Land

RcF—Rough stony land, 15 to 30 percent slopes. This land type is in areas that border drainageways on the uplands. It is 60 to 80 percent or more exposed areas of consolidated sandstone or chalky limestone and 20 to 40 percent areas of Canyon and Kipson soils that are shallow and very shallow over bedrock. Slopes are mostly convex. Areas range from 10 to 320 acres in size.

This land type is excessively drained, and runoff is very rapid. Available water capacity is very low.

Rough stony land, 15 to 30 percent slopes, is barren where the bedrock is exposed, but it has sparse to fair growth of native grasses in the areas of very shallow and shallow soils. The vegetated areas are grazed by livestock.

Capability unit VIIs–3, dryland; Shallow Limy range site; windbreak suitability group 10.

Roxbury Series

The Roxbury series consists of deep, nearly level and very gently sloping, moderately well drained soils on bottom lands of the Republican River. These soils formed in silty alluvium. They have a seasonal high water table at a depth of 6 to 10 feet in most years, but late in summer the water table may fall to a depth of about 15 feet.

In a representative profile the surface layer is grayish brown, very friable silt loam 14 inches thick. The subsoil is grayish brown, friable silt loam 16 inches thick. The underlying material is light brownish gray silt loam in the upper part and gray light silty clay loam in the lower part.

Roxbury soils have moderate permeability and high available water capacity. The organic-matter content

Figure 13.—**Area of Rough broken land, loess, 20 to 60 percent slopes, in the foreground.**

is moderate, and natural fertility is high. These soils release moisture readily to plants.

Roxbury soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Roxbury silt loam, 0 to 2 percent slopes, in a cultivated field, 1,320 feet north and 528 feet east of the center of sec. 11, T. 1 N., R. 15 W.:

Ap—0 to 14 inches, grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

B2—14 to 30 inches, grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; few worm castings; strong effervescence; mildly alkaline; clear smooth boundary.

C1—30 to 46 inches, light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; violent effervescence; mildly alkaline; gradual smooth boundary.

C2—46 to 60 inches, gray (10YR 6/1) light silty clay loam, dark grayish brown (10YR 4/2) moist; few faint yellow (2.5Y 8/6) moist mottles; massive; slightly hard, friable; violent effervescence; moderately alkaline.

The A horizon ranges from 10 to 20 inches in thickness. The B2 horizon is silt loam or light silty clay loam and ranges from 10 to 24 inches in thickness. Depth to lime ranges from 0 to 10 inches.

Roxbury soils are near McCook, Munjor, Hobbs, and Gibbon soils. They have more clay than the McCook and Munjor soils. They contain lime, whereas Hobbs soils are leached of lime. They lack the moderately high water table of the Gibbon soils.

Rx—Roxbury silt loam, 0 to 2 percent slopes. This silty soil is on bottom lands. Areas range from 10 to 400 acres in size.

Included with this soil in mapping were areas of soils that have a subsoil of clay loam and areas that are sandy loam below a depth of 40 inches. Also included were a few small areas of McCook silt loam.

This soil is easily worked. Under dryland management there is a shortage of moisture in some years. A balanced fertilizer program is needed because the lime in the surface layer causes part of the phosphorus to be unavailable to plants.

Almost all the acreage of this soil is cultivated, and a large acreage is irrigated. Corn, alfalfa, and grain sorghum are the principal crops. Capability units I–1, dryland, and I–6, irrigated; Silty Lowland range site; windbreak suitability group 1.

Sandy Alluvial Land

Sa—Sandy alluvial land (0 to 6 percent slopes). This land type is on dry streambeds and the adjacent alluvial flood plains along the upper parts of Thompson and Center Creeks. Areas of this land type are dry during most of the year, but they are flooded after heavy rains. The water table is below a depth of 10 feet.

The streambed consists of stratified sand of various sizes. It ranges from 25 to 175 feet in width and is nearly devoid of vegetation. The adjacent flood plain is 1 foot to 4 feet higher in elevation than the streambed. It ranges in texture from sandy loam to sand of various sizes.

The material in most areas of this land type has not been in place long enough to form a soil profile. Gravel is present in some places but is not common. The surface topography is channeled and is commonly hummocky. Mounds of highly stratified, sandy, recent flood deposits are common. Shallow ponded areas occur in some areas.

Included with this land in mapping were small areas of Inavale soils.

The vegetation on the flood plain consists mainly of sparse stands of sand bluestem, switchgrass, little bluestem, prairie sandreed, sand dropseed and various sedges. Eastern cottonwood and willow trees are in some places.

Nearly all the acreage of this land type is in native grasses and is used for livestock grazing. The areas provide limited food and cover for wildlife. Capability unit VIIw–7, dryland; Sands range site; windbreak suitability group 10.

Scott Series

The Scott series consists of deep, nearly level, poorly drained soils in upland depressions that are frequently flooded. These soils formed in silty loess.

In a representative profile the surface layer is gray, friable silt loam 5 inches thick. The subsurface layer is light gray, friable silt loam 3 inches thick. The subsoil is about 38 inches thick. It is dark gray, very firm silty clay in the upper part, dark gray, very firm clay in the middle part, and light brownish gray, firm silty clay loam in the lower part. The underlying material, at a depth of 46 inches, is pale brown silt loam.

Scott soils have very slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is medium. These soils contain fine, elastic clay that holds some of the soil moisture under too much tension to be extracted by plant roots.

Scott soils are fairly well suited to cultivated crops. They are not suited to grass, trees, and shrubs. They are suited to habitat for some kinds of wetland wildlife.

Representative profile of Scott silt loam, 0 to 1 percent slopes, in native grasses, 1,584 feet east and 50 feet north of the southwest corner of sec. 14, T. 4 N., R. 16 W.:

A1—0 to 5 inches, gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A2—5 to 8 inches, light gray (10YR 6/1) silt loam, gray (10YR 5/1) moist; moderate thin and medium platy structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

B21t—8 to 20 inches, dark gray (2.5Y 4/1) silty clay, very dark gray (2.5Y 3/1) moist; common medium prominent yellowish brown (10YR 5/8, moist) mottles; strong coarse prismatic structure parting to strong medium blocky; very hard, very firm; shiny films on faces of peds; numerous small black concretions of iron or manganese; neutral; clear smooth boundary.

B22t—20 to 34 inches, dark gray (2.5Y 4/1) clay, very dark gray (2.5Y 3/1) moist; few fine distinct yellowish brown (10YR 5/6) moist mottles; strong coarse prismatic structure parting to strong fine blocky; very hard, very firm; shiny films on faces of peds; numerous small black concretions of iron or manganese; neutral; clear smooth boundary.

B3—34 to 46 inches, light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

C1—46 to 56 inches, pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C2—56 to 60 inches. pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, very friable; violent effervescence; mildly alkaline.

The A1 horizon ranges from 2 to 8 inches in thickness, the A2 horizon from 1 inch to 3 inches, and the B2t horizon from 16 to 31 inches. The B2t horizon is silty clay or clay. The C horizon is silt loam or silty clay loam. Depth to carbonates ranges from 35 to 60 inches or more.

Scott soils are near Fillmore, Butler, Detroit, and Holdrege soils. They are more poorly drained than these soils. They have a thinner combined A1 and A2 horizon than Fillmore soils. They have an A2 horizon which is not present in Detroit and Holdrege soils and have more clay in the B2t horizon. They have a thinner A horizon than Butler soils.

Sc—Scott silt loam, 0 to 1 percent slopes. This soil is in potholes or depressions that are frequently flooded, mainly by runoff from higher surrounding areas. Areas range from 20 to 300 acres in size.

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

Flooding is a severe hazard to the use of this soil. The duration of flooding depends on the size of the area and the amount of water received. Unless surface drainage is provided to remove the ponded water, only about one cultivated crop in 10 years can be grown successfully. The surface layer is thin, and cultivation normally mixes the upper part of the subsoil with the plowed layer. Workability is difficult. This soil dries slowly because moisture cannot move readily through the profile. Almost all the water on the surface is lost through evaporation. When the soil is dry, deep cracks extend from the surface into the subsoil.

Most of the acreage of this soil is used for grazing. The drier parts of the areas can be used for cultivated crops in some years. A part of the acreage is idle and is used by wildlife as a source of food and cover. Capability unit IVw–2, dryland; windbreak suitability group 10.

Uly Series

The Uly series consists of deep, gently sloping to steep, well drained soils on uplands. These soils formed in loess.

In a representative profile the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is friable silt loam about 17 inches thick. It is brown in the upper part, pale brown in the middle part, and very pale brown in the lower part. The underlying material, at a depth of 26 inches, is very pale brown silt loam.

Uly soils have moderate permeability and high available water capacity. The organic-matter content is moderately low, and natural fertility is medium. These soils release moisture readily to plants.

Uly soils that have slopes of less than 9 percent are suited to cultivated crops under both dryland and irrigation management. All areas of these soils are suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Uly silt loam, 6 to 11 percent slopes, in native grasses, 1,848 feet north and 264 feet west of southeast corner of sec. 28, T. 2 N., R. 16 W.:

A—0 to 9 inches, dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

B1—9 to 13 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B2—13 to 20 inches, pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; slight effervescence; neutral; clear smooth boundary.

B3—20 to 26 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable; violent effervescence; mildly alkaline; gradual smooth boundary.

C—26 to 60 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; violent effervescence; mildly alkaline.

The solum ranges from 12 to 30 inches in thickness. The A horizon is very dark grayish brown to grayish brown. It is dominantly silt loam, but in small areas it is light silty clay loam. The B horizon ranges from dark grayish brown to very pale brown. Depth to lime ranges from 12 to 25 inches.

Uly soils are near Coly, Holdrege, and Nuckolls soils. They have a B horizon which Coly soils lack. They have less clay in the B horizon than Holdrege soils. They are not leached so deeply as Nuckolls soils and formed in loess that is less reddish in color.

UaC—Uly silt loam, 3 to 6 percent slopes. This soil is on side slopes that border intermittent drainageways and on ridgetops on loess uplands. Areas range from 5 to 160 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thicker.

Included with this soil in mapping were a few, small areas of Holdrege silt loam and of strongly sloping Uly silt loam.

Water erosion is a severe hazard. Soil blowing is also a hazard where the surface is unprotected. Runoff is medium.

Most of the acreage of this soil is in native grasses. A few areas are cultivated. Wheat, grain sorghum, and alfalfa are the cultivated crops grown. Capability units IIIe–1, dryland, and IIIe–6, irrigated; Silty range site; windbreak suitability group 4.

UaD—Uly silt loam, 6 to 11 percent slopes. This soil is on ridgetops and on side slopes that border intermittent drainageways. Areas range from 5 to 80 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were a few small areas of gently sloping Uly silt loam.

Water erosion is a very severe hazard in cultivated areas. In places, small gulleys and rills are present after rains. Soil blowing is also a hazard where the surface is not protected by plant cover.

Most of the acreage of this soil is in native grasses and is used for grazing livestock. Capability units IVe–1, dryland, and IVe–6, irrigated; Silty range site; windbreak suitability group 4.

Valentine Series

The Valentine series consists of deep, moderately steep to very steep, excessively drained soils on uplands. These soils formed in wind-deposited sand. They are hummocky and hilly.

In a representative profile the surface layer is grayish brown, loose loamy sand 5 inches thick. Beneath this is a transition layer that is brown fine sand 4 inches thick. The underlying material, at a depth of 9 inches, is very pale brown fine sand.

Valentine soils have rapid permeability and low available water capacity. The organic-matter content is very low, and natural fertility is low. These soils release moisture readily to plants.

Valentine soils are suited to native grasses to habitat for wildlife and to use for recreation. They are also suited to trees and shrubs if the slope is not too steep.

Representative profile of Valentine loamy sand, hilly, in native grasses, 1,426 feet east and 686 feet north of the southwest corner of sec. 33, T. 4 N., R. 14 W.:

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

AC—5 to 9 inches, brown (10YR 5/3) fine sand, grayish brown (10YR 5/2) moist; weak coarse prismatic structure; loose; slightly acid; clear smooth boundary.

C—9 to 60 inches, very pale brown (10YR 7/4) fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; slightly acid.

The A horizon ranges from 2 to 9 inches in thickness. It is dominantly loamy sand, but in small areas it is loamy fine sand and fine sand. The AC horizon ranges from 3 to 6 inches in thickness.

Valentine soils are near Hersh, Meadin, and Kenesaw soils. They contain more sand than Hersh soils. They have a C horizon that is fine sand, whereas Meadin soils have a C horizon that is mixed coarse sand and gravel. They have more sand than Kenesaw soils, which formed in silty loess.

VaF—Valentine loamy sand, hilly (15 to 60 percent slopes). This deep, sandy soil occurs mainly on hills, ridges, and hummocks on uplands (fig. 14). Slopes are steep and very steep and are mainly convex. Swales and small pockets are common on the landscape. Areas range from 25 to 200 acres in size. This soil has the profile described as representative of the series.

Figure 14.—**An area of Valentine loamy sand, hilly.**

Included with this soil in mapping were a few small areas of Hersh soils and a few blowouts.

Soil blowing is a very serious hazard on this soil. This soil is too steep, loose, and coarse-textured to be cultivated successfully. Where soil blowing is severe, the loose sand is blown onto adjacent areas of grasses, sometimes covering and killing the grasses. This soil is droughty because of the low available water capacity. Runoff is slow or medium, depending on steepness of slope and the kind and amount of plant cover.

Nearly all of the acreage of this soil is in native grasses and is used for grazing. Capability unit VIIe–5, dryland; Choppy Sands range site; windbreak suitability group 10.

VhD—Valentine-Hersh complex, 11 to 30 percent slopes. This complex is on low hills and hummocks on uplands. It is about 50 to 70 percent Valentine soils, 20 to 40 percent Hersh soils, and about 0 to 10 percent other soils. Areas range from 10 to 500 acres in size. Valentine soils are on the highest elevations, and Hersh soils are on the lowest elevations. These soils have profiles similar to the ones described as representative of their respective series, but the surface layer of the Hersh soil is fine sandy loam and in many places the surface layer of the Valentine soil is loamy fine sand.

Included with these soils in mapping were a few small areas of gently sloping Kenesaw silt loam.

Soil blowing is the main hazard to the use of these soils. These soils are too steep, loose, and coarse textured for cultivated crops, and they are droughty because available water capacity is low or moderate. Loose sand from active blowouts is a hazard to surrounding vegetation. Runoff is slow because most of the moisture is readily absorbed.

Almost all the acreage of this complex is in native grasses and is used as rangeland. Capability unit VIe–5, dryland; Valentine soil in Sands range site and Hersh soil in Sandy range site; windbreak suitability group 10.

Wann Series

The Wann series consists of deep, nearly level, somewhat poorly drained soils on bottom lands. These soils formed in recent alluvium. They have a seasonal high water table that is at a depth of 2 to 4 feet in most years, but late in summer the water table may fall to a depth of about 6 feet.

In a representative profile the surface layer is gray and dark grayish brown, very friable fine sandy loam 11 inches thick. The underlying material is light brownish gray. It is sandy loam in the upper part and mixed loamy sand and gravel in the lower part.

Wann soils have moderately rapid permeability and moderate available water capacity. The organic-matter content is moderately low, and natural fertility is medium. These soils release moisture readily to plants.

Wann soils are suited to cultivated crops under both dryland and irrigation management. They are also suited to grasses, trees, and shrubs, to habitat for wildlife, and to recreational uses.

Representative profile of Wann fine sandy loam, 0 to 2 percent slopes, in a cultivated field, 4,118 feet east and 50 feet north of the southwest corner of sec. 18, T. 2 N., R. 16 W.:

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

A12—5 to 11 inches, dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak medium granular; soft, very friable; slight effervescence; moderately alkaline; abrupt wavy boundary.

C1—11 to 42 inches, light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; common fine distinct yellowish brown (10YR 5/4) moist mottles; massive; slightly hard, very friable; slight effervescence; moderately alkaline; clear wavy boundary.

C2—42 to 60 inches, light brownish gray (10YR 6/2) loamy sand that has 7 to 15 percent gravel, dark grayish brown (10YR 4/2) moist; single grained; loose; slight effervescence; moderately alkaline.

The A horizon ranges in thickness from 11 to 16 inches. It is dominantly silt loam and fine sandy loam, but in some areas it is also loam and sandy loam.

Wann soils are near Munjor, McCook, Inavale, and Gibbon soils. They have a higher water table than Munjor, McCook, and Inavale soils. They contain more sand between the depths of 10 and 40 inches than McCook soils. They have less sand in the upper part of the C horizon than Inavale soils. They have more sand in the C horizon than Gibbon soils.

Wa—Wann fine sandy loam, 0 to 2 percent slopes. This loamy soil is on bottom lands of the Republican River and some of its major tributaries. Areas range from 20 to 250 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping were a few small areas of Gibbon silt loam, Wann silt loam, and Munjor fine sandy loam.

This soil is commonly too wet during spring for timely seedbed preparation. Where dryfarmed, it is droughty in late summer when the water table is lowest. Fertility needs to be balanced. Phosphorus is not readily available, because lime is near the surface. Soil blowing is a hazard. This soil is easily worked when it is not too wet.

Most of the acreage of this soil is in crops. Some fields are dryfarmed, and some are irrigated. Corn, grain sorghum, wheat, and alfalfa are the main crops. A few areas are in native grasses. Capability units IIw–6, dryland, and IIw–8, irrigated; Subirrigated range site; windbreak suitability group 2.

Wb—Wann silt loam, 0 to 2 percent slopes. This silty soil is on bottom lands. Areas range from 20 to 640 acres in size. This soil has a profile similar to the one described as representative of the series, but the surface layer is silt loam.

Included with this soil in mapping were small areas of Gibbon silt loam, McCook silt loam, and Wann fine sandy loam.

This soil is commonly too wet during spring for timely seedbed preparation. Where the soil is dryfarmed, it is droughty late in summer, when the water table is lowest. Fertility needs to be balanced. Phosphorus is not readily available, because lime is near the surface. Soil blowing is a hazard. This soil is easily worked when it is not too wet.

Most of the acreage of this soil is cultivated. Some fields are dryfarmed, and some are irrigated. Corn, grain sorghum, wheat, and alfalfa are the main crops. A few areas are in native grasses. Capability units IIw–4, dryland, and IIw–8, irrigated; Subirrigated range site; windbreak suitability group 2.

Use and Management of the Soils

This section explains how the soils in Franklin County can be used for crops. It also gives extensive information about the use of soils for range, for windbreaks, for wildlife, and for recreation. This section describes the uses of soils for engineering purposes. The information in this section will be useful in applying basic knowledge about the soils to plans and decisions in use and management of the soils.

Crops [2]

The major concerns in management when the soils are used for crops are described in this section. This section explains the capability grouping used by the Soil Conservation Service. It tells of general management needed on soils used for dryfarmed and irrigated crops and explains in detail the management by dryland and irrigated capability units. Also in this section is a table that shows predicted yields of the principal dryfarmed and irrigated crops grown in the county.

In Franklin County approximately 53 percent of the land area is cultivated and 42 percent is range. Grain sorghum, corn, and alfalfa are the major crops. Corn is the main dryfarmed and irrigated crop. Minor acreage are in tame hay or in summer fallow.

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 limitation of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the sub-

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class, 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 or require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants or require very careful management, or both.
- Class V soils are subject to little or no erosion but have other limitations impractical to remove, that limit their use largely to pasture, range, or wildlife habitat. (None in Franklin County.)
- 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 habitat.
- 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 habitat.
- Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, and water supply or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

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.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass or kind of limitation as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management of dryland soils

Good management practices for soils that are cultivated without benefit of irrigation are those that reduce runoff and risk of erosion, conserve moisture, and improve fertility. Water erosion on the uplands, flooding adjacent to streams, and fertility loss by excessive removal of topsoil are the principal concerns in management in Franklin County. Most of the soils are suitable for crops when these hazards and limitations are reduced or corrected by suitable management practices.

Terracing, contour farming, contour-bench land leveling, contour-furrow land leveling and terracing, using grassed waterways and conservation tillage, and keeping crop residue on the surface help to control water erosion. Keeping crop residue on the surface or growing a protective plant cover reduces sealing and crusting of the soil during and after heavy rains. In winter tall stubble catches drifting snow and provides additional moisture.

The hazard of soil blowing can be reduced by the same management that conserves soil moisture. Examples are the use of stubble mulch, conservation tillage, crop residue, wind stripcrops, and narrow field windbreaks.

Erosion can be reduced if the more productive soils, where the hazard of erosion is slight, are used for row crops and the steeper, more eroded soils are used for hay and pasture. Proper land use, alone, can reduce the potential for erosion in many places. Keeping tillage at time of seedbed preparation to a minimum and leaving the maximum amount of crop residue on the surface improves tilth, reduces erosion, and lessens compaction.

In Franklin County soils that are used for crops and pasture should be tested to determine the need for commercial fertilizer. For dryland soils, the kind and amounts of fertilizer to be applied should be based on results of soil tests and on the content of moisture in the soil. On areas where the subsoil is dry and rainfall is low, the amount of fertilizer applied should be slightly lower than the amount applied on wetter soils.

The following paragraphs describe the capability units for dryland soils. Each unit consists of soils that have similar management requirements, soil hazards, limitations, and concerns in management. Suitable practices to help overcome the soil limitations are given. The capability units in which all the soils are placed are given in the "Guide to Mapping Units."

CAPABILITY UNIT I-1, DRYLAND

This unit consists of deep, nearly level, moderately well drained or well drained soils on bottom lands and foot slopes. The surface layer is silt loam. The transition layer or subsoil is silt loam. The underlying material is very fine sandy loam, sandy loam, silt loam, or light silty clay loam.

These soils have moderate permeability and high available water capacity. The organic-matter content is moderately low or moderate, and natural fertility is high. These soils absorb moisture easily and release it readily to plants. They are easy to work. Runoff is slow.

The main concerns in management are maintaining high fertility and preventing soil blowing.

These soils are some of the best in the county for the production of cultivated crops. They are suited to all the commonly grown crops. Returning crop residue to the soil is about the only management practice needed. Alternating row crops with small grain and hay helps to control diseases and insects. Conservation tillage helps to prevent soil blowing, increases the organic-matter content of the surface layer, and increases the water intake rate.

CAPABILITY UNIT IIc-1, DRYLAND

This unit consists of deep, nearly level, well drained or moderately well drained soils on uplands and stream terraces. The surface layer is silt loam. The subsoil is silt loam, light silty clay loam, silty clay loam, heavy silty clay loam, light silty clay, or silty clay. The underlying material is silt loam.

These soils have moderate to slow permeability and high available water capacity. The organic-matter content is moderately low or moderate, and natural fertility is high. These soils are easily tilled. They absorb moisture easily and release it readily to plants. Runoff is slow.

Lack of adequate rainfall to meet crop needs is the main limitation. Soil blowing is a slight hazard in areas that are not adequately protected. The principal concern in management is conservation of the available moisture. Minor concerns are control of water erosion and maintenance of organic-matter content, high fertility, and good tilth.

Corn, sorghum, small grain, and alfalfa are the main crops suited to these soils. These soils are droughty almost every summer because of limited rainfall. Small grain and the first cutting of alfalfa are generally more dependable crops because they grow and mature in spring when rainfall is highest.

Soil erosion can be reduced and moisture conserved by using a cropping system that keeps the soil covered with crop residue most of the time. Close growing crops, such as alfalfa, help to increase the supply of organic matter, raise the level of fertility, and protect the soil from erosion. Stubble mulch tillage, which leaves crop residue on the surface, helps to conserve moisture, to increase the water intake rate, and to reduce the loss of moisture by evaporation.

CAPABILITY UNIT IIe-1, DRYLAND

This unit consists of deep, very gently sloping, well drained soils on uplands and stream terraces. The surface layer is silt loam. The subsoil is silt loam or silty clay loam, and the underlying material is silt loam.

These soils have moderate permeability and high available water capacity. The organic-matter content is moderately low or moderate, and natural fertility is high. These soils absorb moisture easily and release it readily to plants. They are easily tilled. Runoff is slow or medium.

Water erosion is the main limitation when these soils are cultivated. Conserving moisture by preventing runoff is a major concern in management. Soil blowing is a slight hazard. Natural rainfall is commonly inadequate to meet crop needs.

These soils are suited to corn, sorghum, small grain, and alfalfa. Keeping crop residue on the surface by conservation tillage, terracing, contour farming, and using grassed waterways help to control runoff. A cropping system that keeps the soil covered with vegetation most of the time also helps to reduce the loss of moisture.

CAPABILITY UNIT IIe-3, DRYLAND

This unit consists of deep, nearly level, well drained soils on bottom lands. The surface layer is fine sandy loam. The transition layer and underlying material are fine sandy loam, sandy loam, or silt loam. In some areas, coarse sand and medium sand are in the lower part of the underlying material.

These soils absorb rainfall readily, and release moisture readily to plants. These soils have moderate or moderately rapid permeability and moderate or high available water capacity. The organic-matter content is moderately low or low, and natural fertility is medium or high. Runoff is slow.

These soils are subject to soil blowing and water erosion. During some years, there is not sufficient moisture from natural rainfall for growing crops under dryland management. Conserving moisture and maintaining fertility and organic-matter content are needed. Phosphorus is not readily available. Improving and maintaining soil fertility are needed in management.

These soils are suited to corn, sorghum, small grain, and alfalfa. Water erosion and soil blowing can be reduced and moisture conserved by stripcropping, by using conservation tillage that keeps the crop residue on the surface, and by using a cropping system that includes grass or legumes and keeps the soil covered most of the time. A conservation tillage system of planting row crops that keeps crop residue on the surface and the use of contour farming, terraces, and grassed waterways are needed where the soils are used mainly for row crops.

CAPABILITY UNIT IIw-2, DRYLAND

Butler silt loam, 0 to 1 percent slopes, is the only soil in this unit. It is a deep, somewhat poorly drained soil, and it has a claypan. The surface layer is a silt loam. The subsoil is clay, silty clay, and silty clay loam. The underlying material is silt loam.

This soil has slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. This soil absorbs moisture slowly and releases it slowly to plants. Runoff is very slow.

Water stands on the surface of this soil after heavy rains. Planting, therefore, can be delayed or crops can be damaged by the excess water. Soil blowing is a limitation where the surface is left bare. During summer, when rainfall is lowest, this soil is droughty in places. This is because most of the available moisture is above the claypan subsoil, and because the moisture in the claypan layer is released only slowly to plants.

This soil is suited to corn, sorghum, small grain, and alfalfa. Production of alfalfa and other close growing crops improves the tilth of the surface layer, in-

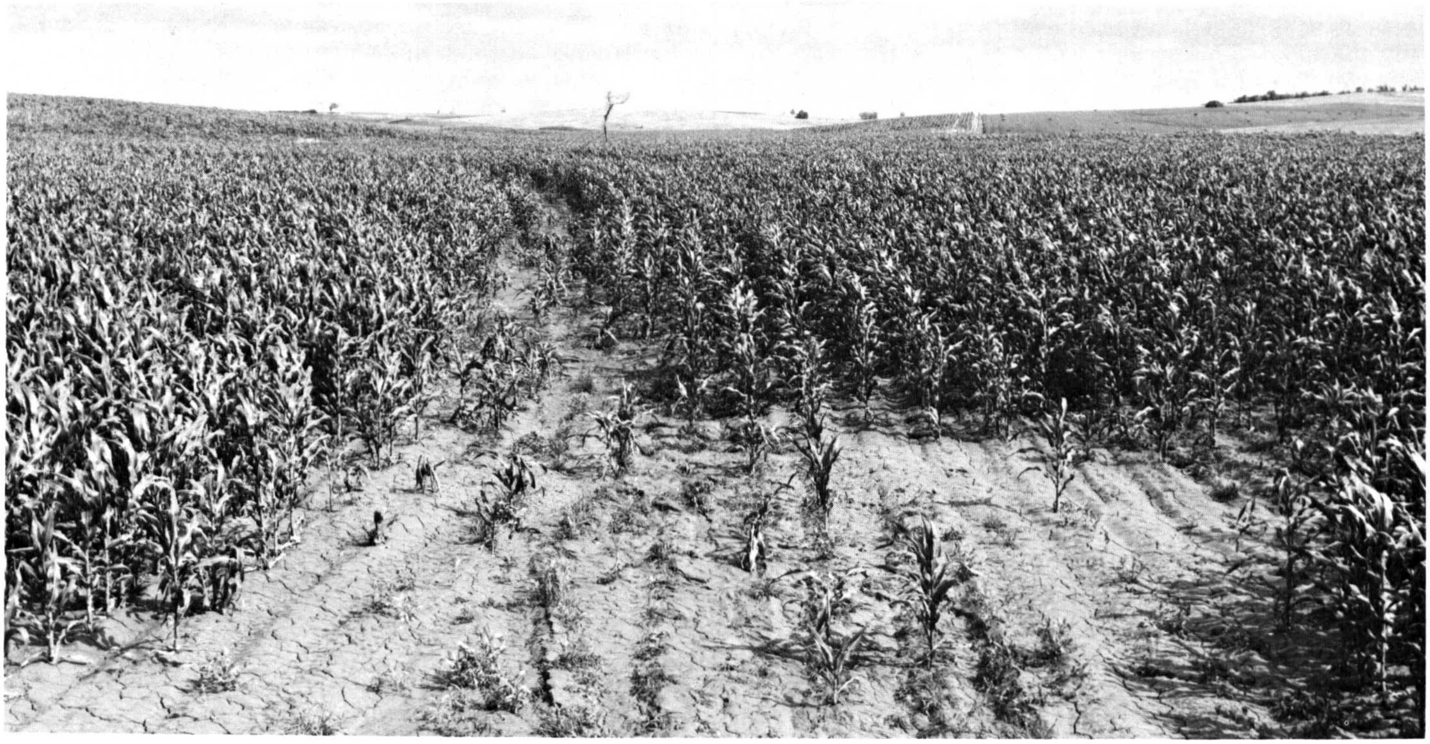

Figure 15.—**Corn damaged by flooding on Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes.**

creases the permeability, and helps to keep the claypan soil open. A system of conservation tillage that keeps crop residue on the surface also improves tilth and permeability and, in addition, helps to maintain the organic-matter content. Conservation tillage also protects the soil from blowing. Intercepting runoff from higher lying soils by means of terraces or diversions protects crops from damage by excess water.

CAPABILITY UNIT IIw-3, DRYLAND

Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes, is the only soil in this unit. This soil is deep and is moderately well drained. It is on bottoms of upland drainageways and is flooded about once each year. It is silt loam throughout.

This soil has moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. This soil absorbs moisture easily and releases it readily to plants. It is easy to work if the surface is dry. Runoff is medium.

Occasional flooding after heavy rains is the major limitation of this soil (fig. 15). During dry years, occasional flooding is beneficial to crops if it is not too rapid or too prolonged.

This soil is suited to corn, sorghum, small grain, and alfalfa. Flooding in spring occasionally delays planting and cultivation; thus production of small grain and alfalfa is limited. In most areas, diversions and drainage ditches are needed to intercept runoff and to keep it from spreading over a wide area.

CAPABILITY UNIT IIw-4, DRYLAND

This unit consists of deep, nearly level, somewhat poorly drained soils on bottom lands. The surface layer is silt loam or silty clay loam. The underlying material is very fine sandy loam and sandy loam. In some areas, loamy sand mixed with gravel is in the lower part of the underlying material. The water table fluctuates between the depths of 2 and 6 feet. These soils are subirrigated. They are calcareous.

These soils have moderately slow or moderately rapid permeability, and high or moderate available water capacity. The organic-matter content is moderate or moderately low, and natural fertility is medium or high. These soils are easy to work when they are not too wet. Runoff is slow.

Wetness is the main limitation. The water table is commonly highest in spring, and early tillage is usually delayed. In places, soluble salts accumulate on the surface, but these are washed away by rains. In dry years, the moderately high water table can be beneficial to dryfarmed crops. Fertility and organic-matter content need to be maintained. Phosphate is not readily available because the soils are calcareous.

These soils are suited to corn, sorghum, and alfalfa. They are less suited to spring-sown small grain, because the water table is high in spring and timely tillage is generally not possible. Diversions, drainage ditches, and tile drains help to control wetness.

CAPABILITY UNIT IIw-6, DRYLAND

Wann fine sandy loam, 0 to 2 percent slopes, is the only soil in this unit. This soil is deep and somewhat poorly drained. It is on bottom lands. The surface layer is fine sandy loam, and the underlying material commonly is sandy loam. In some areas loamy sand mixed with gravel is in the lower part of the underlying material. The water table fluctuates between the depths of 2 and 6 feet. This soil is subirrigated. It is calcareous.

This soil has moderately rapid permeability and moderate available water capacity. The organic-matter content is moderately low, and natural fertility is medium. This soil absorbs moisture easily and releases it readily to plants. It is very friable and is easy to work when it is not too wet. Runoff is slow.

Because of the high water table, wetness is the main limitation. When the water table is highest, the soil is too wet to cultivate easily. Soil blowing is a limitation when the surface is bare and dry. The organic-matter content and fertility level need to be improved and maintained. Phosphate is not readily available, because this soil is calcareous.

Corn, sorghum, and alfalfa are well suited to this soil. Spring-sown small grain is not well suited, because wetness in spring delays seedbed preparation. Stands of alfalfa are thin in some areas because of the high water table. Where suitable outlets are available, the water table can be lowered by using drainage ditches or tile drains. Growing alfalfa or other close-growing crops at regular intervals is beneficial. Alfalfa eliminates the need for tillage in spring and protects the soil from blowing. Returning crop residue to the soil helps to maintain the organic-matter content and reduce soil blowing.

CAPABILITY UNIT IIIe-1, DRYLAND

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

These soils have moderate permeability and high available water capacity. The organic-matter content is moderate or moderately low, and natural fertility is high or medium. These soils absorb moisture easily and release it readily to plants. They are easy to work. Runoff is medium.

Water erosion is the main limitation to the use of these soils. Soil blowing is a slight hazard. Conserving moisture by preventing runoff is a major concern in management. Rainfall is commonly inadequate to meet crop needs.

Corn, sorghum, small grain, and alfalfa are well suited to these soils. Crops are subject to damage late in summer, when rainfall is generally limited. Terraces, grassed waterways, contour farming, and conservation tillage that leaves the crop residue on the surface reduce the rate of runoff and the hazard of erosion. Water erosion can be reduced and moisture conserved by using a cropping system that keeps the soil covered with crops or crop residue most of the time. Such practices as use of a cropping system that limits row crops to 1 or 2 years in succession and use of conservation tillage that leaves crop residue on the surface are effective in helping to control erosion. Gullied areas can be shaped and seeded to grass. Grassed field borders help to control runoff and can be used as turnrows, roadways, and wildlife areas.

CAPABILITY UNIT IIIe-3, DRYLAND

This unit consists of deep, nearly level to gently sloping, well drained or excessively drained soils on uplands and bottom lands. The surface layer is fine sandy loam or loamy sand. The transition layer and the underlying material are loamy sand or fine sand.

These soils have moderately rapid or rapid permeability and moderate or low available water capacity. The organic-matter content is low or very low, and natural fertility is medium or low. The surface layer is very friable or loose and is easily worked. Runoff is medium to very slow, depending mostly on the slope and vegetative cover.

Soil blowing is the main limitation to the use of these soils. Conservation of moisture is a major concern in management. Water erosion is a slight hazard. Rainfall is commonly inadequate to meet crop needs. Plant nutrients are leached in places where the underlying material is coarse textured.

Corn, sorghum, small grain, and alfalfa are suited to these soils. Because of the moderate or low available water capacity, these soils are somewhat droughty. Soil blowing and water erosion can be reduced and moisture conserved by use of stripcropping, a conservation tillage that keeps the crop residue on the surface, and a cropping system that keeps the soil covered with residue most of the time. Such practices are also good land treatment.

CAPABILITY UNIT IIIe-5, DRYLAND

Munjor loamy fine sand, 0 to 2 percent slopes, is the only soil in this unit. This soil is deep and well drained. It is on bottom lands. The surface layer is calcareous loamy fine sand. The upper part of the underlying material is calcareous sandy loam, and the lower part is coarse and medium sand.

This soil has moderately rapid permeability and moderate available water capacity. The organic-matter content is low, and natural fertility is medium. This soil absorbs moisture easily and releases it readily to plants. This soil is easy to till. Runoff is slow.

Soil blowing is the major limitation. Conservation of moisture and leaching of plant nutrients are important concerns in management. Phosphate is not readily available, because the soil is calcareous.

Corn, sorghum, small grain, and alfalfa are suited to this soil. Small grain and the first cutting of alfalfa are generally the most dependable crops because they grow and mature in spring when rainfall is plentiful. A cropping system that keeps the soil covered with crop residue most of the time, limits the number of consecutive years of row crops, and includes close-growing crops in the system protects the soil, conserves moisture, and reduces the hazards of soil blowing and water erosion. A system that uses alternating close-growing crops and row crops in narrow strips and that provides for the planting of single row windbreaks also helps to control soil blowing.

CAPABILITY UNIT IIIw-2, DRYLAND

Fillmore silt loam, 0 to 1 percent slopes, is the only soil in this unit. This soil is deep and is in upland depressions. The surface layer is silt loam. The subsoil is silty clay, and the underlying material is silt loam.

This soil has very slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. This soil absorbs moisture slowly and releases it slowly to plants. It is ponded after heavy rains, but it is dry during mid-summer.

This soil is flooded at least once each year by runoff water from surrounding higher soils. The flooding occurs commonly during spring. It delays tillage and retards crop growth, but a complete crop loss is not common. This soil can be droughty in mid-summer, because the silty clay subsoil slowly releases moisture to plants. Soil blowing can be a limitation in the driest season if the surface is not protected.

This soil is suited to corn, sorghum, and alfalfa. It is poorly suited to seeding of small grain and alfalfa in spring when the water table is high. Wetness generally delays tillage and cultivation early in spring. Terraces and diversions in the higher lying surrounding areas help to control excess runoff water from flooding areas of these soils. Drainage ditches help to remove excess water from the surface, so that tillage can be timely. Conservation tillage methods of planting row crops protect the soil from blowing during periods of drought.

CAPABILITY UNIT IVe–1, DRYLAND

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

These soils have moderate permeability and high available water capacity. The organic-matter content is moderate or moderately low, and natural fertility is high or medium. These soils absorb moisture easily and release it readily to plants. They are easy to work. Runoff is medium.

Water erosion is the main limitation to the use of these soils. In places, rills and small gullies are plowed during tillage. Conserving moisture by controlling runoff is a principal concern in management. Soil blowing is a slight hazard in cultivated areas. Rainfall is commonly inadequate to meet crop needs.

Soils in this unit are not well suited to row crops, because runoff after rains can result in moisture loss and severe water erosion. They are better suited to small grain, grass, and alfalfa than to row crops. They are marginal for cultivated crops, but they can be seeded to native grasses where this use fits into a livestock program.

Terraces, grassed waterways. contour farming, and conservation tillage that leaves the crop residue on the surface help to reduce runoff and erosion. A good cropping system includes small grain, grass, and alfalfa and limits the use of row crops. Such practices as conservation tillage and a good cropping system that includes grass and alfalfa and such mechanical practices as terraces and grassed waterways are needed if these soils are to be cultivated and production is to remain high. Shaping and seeding of gullied areas and use of grassed waterways are needed on the most severely eroded areas. Grassed field borders help to control runoff. They can be used as turnrows, roadways, and wildlife habitat. If these soils are used as range, an adequate cover of vegetation is needed to reduce runoff and help control erosion. Proper grazing use and a planned grazing system help to keep the grasses healthy and productive.

CAPABILITY UNIT IVe–3, DRYLAND

The soils in this unit are in the Hersh-Valentine complex, 6 to 11 percent slopes. These soils are deep and are well drained or excessively drained. They are on hummocky uplands. The surface layer is fine sandy loam or loamy sand. The transition layer is sandy loam or fine sand. The underlying material is sandy loam, loamy sand, and fine sand.

These soils have moderately rapid and rapid permeability and moderate and low available water capacity. The organic-matter content is low or very low, and natural fertility is medium or low. These soils absorb moisture easily and release it readily to plants. They are easily tilled. Runoff is medium.

Soil blowing is the main limitation to the use of these soils. Conservation of moisture and leaching of plant nutrients are the major concerns in management. Rainfall is commonly inadequate to meet crop needs, and crops can burn in years of below normal rainfall.

Small grain and alfalfa are generally better suited than row crops because they grow and mature in spring when rainfall is more plentiful. Conservation tillage that leaves the crop residue on the surface reduces soil blowing, conserves moisture, and increases the organic-matter content of the soil. A cropping system that limits the use of row crops and keeps the soil covered with crop residue and grass and that is used along with stripcropping and field borders helps to control soil blowing. Windbreaks that are narrow or consist of only one row of trees also help.

CAPABILITY UNIT IVe–5, DRYLAND

Inavale loamy sand, 0 to 3 percent slopes, is the only soil in this unit. This soil is deep and excessively drained. It is on bottom lands. The surface layer and transition layer are loamy sand. The underlying material is sand.

This soil has rapid permeability and low available water capacity. The organic-matter content and natural fertility are low. Moisture is absorbed rapidly and released readily to plants. When dry, this soil is loose and is difficult to work. Runoff is slow.

Soil blowing is a limitation to the use of this soil. The soil is droughty because of the low available water capacity. Excessive leaching of plant nutrients is common. Rainfall is commonly inadequate to meet the needs of crops.

Corn, sorghum, small grain, and alfalfa are well suited to this soil. Small grain and the first cutting of alfalfa are generally better suited than row crops, because they grow and mature in spring when rainfall is plentiful. Starting crops on this soil is sometimes difficult because soil blowing can destroy many of the young plants early in spring. Soil blowing can be reduced, moisture conserved, and organic-matter content and fertility maintained by using a cropping system that keeps the soil covered with crops, grass, or crop residue and by using a conservation tillage method of planting row crops. Soil blowing can also be reduced by use of stripcropping, grassed field borders, and a narrow windbreak consisting of one row of trees.

CAPABILITY UNIT IVe-8, DRYLAND

This unit consists of deep, gently sloping and strongly sloping well drained soils on uplands. These soils are eroded. They have been cultivated. The surface layer and subsoil are silt loam or silty clay loam. The underlying material is silt loam. The surface layer of eroded soils is thinner and lighter colored than the surface layer of uneroded soils of the same series.

These soils have moderate permeability and high available water capacity. The organic-matter content and natural fertility are low. These soils have lost most of their natural fertility through erosion. In many places the surface layer is firm, and tillage is difficult. Runoff is medium. Moisture is not absorbed so readily as in areas of soils that have higher organic-matter content. Rills and small gullies are common in cultivated areas.

Water erosion is a severe hazard. Conserving moisture by preventing runoff is a major concern in management. Soil blowing is a slight hazard. Rainfall is commonly inadequate to meet crop needs.

This soil is marginal for corn or sorghum. It is better suited to small grain and alfalfa than to row crops. Cultivated crops are subject to stress or damage almost every summer because of limited rainfall. A combination of such practices as terraces, grassed waterways, contour farming, and conservation tillage that keeps the crop residue on the surface is needed to help control runoff and erosion. The hazard of water erosion can be reduced and moisture can be conserved by using a cropping system that keeps the soil covered with crop residue most of the time. The best results are obtained by using a cropping system that does not include row crops in consecutive years but does include grass and alfalfa most of the time. In places these soils can be better used as range than for most other uses. They can be seeded to a native grass mixture and managed as range.

CAPABILITY UNIT IVe-9, DRYLAND

Only Coly-Uly silt loams, 3 to 9 percent slopes, eroded, is in this unit. These soils are deep and eroded and are on uplands. They have been cultivated. The surface layer, subsoil, and underlying material are silt loam. Most areas are calcareous at a depth of 12 inches or less.

These soils have moderate permeability and high available water capacity. The organic-matter content and natural fertility are low. These soils absorb moisture easily and release it readily to plants. They are friable and easy to work. Runoff is medium.

Water erosion is the main limitation to the use of these soils. Small gullies are common. Soil blowing is a limitation where the soils are not protected by vegetation. Conserving moisture by slowing the runoff is a main concern in management. Rainfall is commonly inadequate to meet crop needs. Organic-matter content and fertility level need to be increased.

These soils are marginal for corn and sorghum. They are better suited to small grain and alfalfa than to row crops. Crops are subject to stress or damage almost every summer because of limited rainfall. Such practices as terraces, grassed waterways, contour farming, and conservation tillage that leaves the crop residue on the surface are needed to help control runoff and erosion. Water erosion can be reduced and moisture can be conserved by using a cropping system that keeps the soils covered with crop residue most of the time. The best results are obtained by using a cropping system that does not include row crops in consecutive years, but does include grass and alfalfa most of the time. On some farms these soils are better suited to range than to other uses if they are reseeded to native grasses.

CAPABILITY UNIT IVw-2, DRYLAND

Scott silt loam, 0 to 1 percent slopes, is the only soil in this unit. This soil is deep and poorly drained. It is in depressions on uplands. The surface layer is silt loam. The subsoil is clay, silty clay, and silty clay loam. The underlying material is silt loam.

This soil has very slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is medium. This soil absorbs moisture slowly and releases it slowly to plants. It is difficult to till because the surface layer is thin, and tillage commonly brings up material from the sticky, very firm clay subsoil.

Several times each year this soil is flooded by water from adjacent, higher lying soils. This soil is droughty during mid-summer after the floodwaters have evaporated and when rainfall is lowest. The claypan subsoil effectively slows the movement of moisture to plants. Soil blowing is a limitation in places where the surface is left bare.

This soil is marginal for cultivated crops. When used for cropland, it is better suited to row crops, such as corn and sorghum, than to small grain and alfalfa. In spring, timely planting of row crops and tillage of the soil are difficult because wetness is common. Terraces and diversions can be installed on the adjacent, higher lying soils to keep the excess water from flooding depressions. Where an outlet is available, drainage ditches can be used to remove the excess water from these soils so that tillage and planting operations can be timely. Crop residue can be left on the surface to help control soil blowing during the drier part of the year.

CAPABILITY UNIT VIe-1, DRYLAND

This unit consists of shallow, moderately deep, and deep, moderately steep and steep, well drained, somewhat excessively drained, or excessively drained soils. These soils are on uplands. The surface layer is loam or silt loam. The subsoil, transition layer, and underlying material are gravelly sandy loam, loam, or silt loam. The shallow soils are over mixed coarse sand and gravel. The moderately deep and deep soils formed in material weathered from limy sandstone.

These soils have moderate or rapid permeability. The available water capacity ranges from low to high. The organic-matter content is low or moderate, and natural fertility is low or medium. These soils absorb moisture easily and release it readily to plants. Runoff is medium.

Water erosion is a severe hazard on these soils. Soil blowing is a limitation in places where the surface is not adequately protected.

These soils are suited to range, hay, and trees and to other less intensive uses. They are not suited to the commonly grown cultivated crops, because they are too steep and the hazard of water erosion on the steep slopes is too great. When these soils are used as range, proper grazing use, planned grazing systems, and control of weeds and brush are needed to maintain and improve the stand of grass. Dams along the drainageways can be used to impound water for livestock or for recreational purposes.

CAPABILITY UNIT VIe-5, DRYLAND

Only the Valentine-Hersh complex, 11 to 30 percent slopes, is in this unit. The soils are deep, moderately steep and steep, and are on hummocky uplands. The surface layer is loamy fine sand, loamy sand, or fine sandy loam. The transition layer is fine sand or sandy loam, and the underlying material is loamy sand or fine sand.

These soils have moderately rapid or rapid permeability and moderate or low available water capacity. The organic-matter content is low or very low, and natural fertility is medium or low. Runoff is very slow.

Soil blowing is a severe hazard in areas that do not have a good cover of permanent vegetation. Proper range use is the main concern in management.

These soils are poorly suited to cultivated crops because they are sandy, droughty, steep, and erodible. They are better suited to range. When they are used as range, a proper stocking rate, a planned grazing system, and the control of weeds and brush are needed to maintain a good stand of grass and to improve the condition of the range. These soils are also suited to trees, to development of habitat for wildlife, and to use as recreational areas. Areas that are cultivated should be seeded to native grasses and used for hay or pasture.

CAPABILITY UNIT VIe-9, DRYLAND

Only Coly and Uly silt loams, 9 to 30 percent slopes, are in this unit. These soils are deep and well drained or somewhat excessively drained. They are on uplands. The surface layer, subsoil, and underlying material are silt loam.

These soils have moderate permeability and high available water capacity. The organic-matter content is low or moderately low, and natural fertility is low or medium. These soils absorb moisture easily and release it readily to plants. Runoff is rapid, mainly because of the slope.

Water erosion is a severe hazard in the use of these soils. The soils are too steep and erodible for common cultivated crops.

Most of the acreage is in native grasses and is used for grazing of livestock or production of hay. Proper stocking, a planned grazing system, and control of weeds and brush are needed to maintain or improve the condition of pasture. The areas that are now cultivated are severely eroded. These can be retired from cultivation, seeded to native grasses, and converted to range. These soils are also suited to trees, to development of habitat for wildlife, and to use as recreational areas. Dams for livestock water, erosion control structures, and floodwater detention reservoirs can be constructed on the bottoms of some drainageways.

CAPABILITY UNIT VIs-4, DRYLAND

This unit consists of moderately steep and steep, shallow and moderately deep, well drained or somewhat excessively drained soils. These soils are on uplands. The surface layer, transition layer, and underlying material are loam or silt loam. These soils formed in weathered sandstone or limestone. Limestone outcrop is at the surface in some places.

These soils have moderate permeability and low or very low available water capacity. The organic-matter content is moderately low, and natural fertility is medium or low. Runoff is variable, ranging from slow to rapid, depending on the slope and texture of the soil.

Soil depth and steepness of the slope are the main limitations to the use of these soils. Water erosion and soil blowing are also limitations. Proper use of the range is a major concern in management. The soils are droughty, because they lack sufficient depth to store much moisture.

Most of the acreage is used for range. Proper stocking rate, a planned grazing system, and control of weeds and brush are needed to maintain or increase the grass cover and to reduce erosion. These soils are also suited to trees, to development of habitat for wildlife, and to use for recreational purposes.

CAPABILITY UNIT VIw-7, DRYLAND

Only Broken alluvial land is in this unit. This land type consists of fine-textured to medium-textured soil material that is deep and silty, deep and stratified, or, in places, is shallow over sand. Areas are on bottom lands that are flooded several times each year and are deeply channeled in places.

The soil material has moderate to slow permeability and high to low available water capacity. The organic-matter content is moderate, and natural fertility is high to low. The soil material absorbs moisture easily and releases it readily to plants. Runoff is slow to medium.

Frequent flooding is the main limitation. Also, the areas are nearly inaccessible because of the deeply entrenched stream channels.

Most of the acreage is used for permanent pasture. Areas are not suited to the common cultivated crops because of frequent flooding, but they are suited to trees and to development of habitat for wildlife.

CAPABILITY UNIT VIIe-5, DRYLAND

Only Valentine loamy sand, hilly, is in this unit. This soil is deep, steep and very steep, and excessively drained. It is on uplands that are choppy. The surface layer is loamy sand, and the transition layer and underlying material are fine sand.

This soil has rapid permeability and low available water capacity. The organic-matter content and natural fertility are low. Runoff is medium or slow, depending on the slope and the amount of plant cover.

Soil blowing is a very severe hazard on this soil. Proper range use and a deferred grazing system are important concerns in management. Slopes and the coarse texture of the soil are limitations to commonly grown cultivated crops.

This soil is not suitable for cultivation, because it is sandy, droughty, and very erodible. It is suited only to grass and trees, to development of habitat for wildlife, and to use as recreational areas. Careful management of the vegetation is needed if soil blowing is to be controlled. Such conservation management practices as proper range use, a planned grazing system, and a proper stocking rate are needed to maintain the grass resource on this soil.

CAPABILITY UNIT VIIe-9, DRYLAND

Only Rough broken land, loess, 20 to 60 percent slopes, is in this unit. Areas of this land type are steep and very steep. They contain bluffs and canyons and are on the uplands. The soil material is deep, has medium texture, and is excessively drained. "Catsteps" are common.

The soil material has moderate permeability and high available water capacity. The organic-matter content is low or very low, and natural fertility is low. Runoff is very rapid.

Water erosion is the main limitation, because of very rapid runoff from the steep slopes. Soil blowing is also a limitation, particularly in areas where vegetation is not established.

This land type is not suitable for the common cultivated crops, because it is too steep and erodible. It is suited only to grass and trees, to development of habitat for wildlife, and to use as recreational areas. Most of the acreage is used for permanent range. A good cover of grass or a planned grazing system reduces water erosion and conserves moisture on the very steep slopes. Dams for impounding water for livestock and erosion control structures can be built on the bottoms of some drainageways.

CAPABILITY UNIT VIIs-3, DRYLAND

Only Rough stony land, 15 to 30 percent slopes, is in this unit. Areas of this land type are excessively drained. They are on uplands. They consist of 60 to 80 percent consolidated sandstone or chalky limestone outcrop and 20 to 40 percent very shallow and shallow soils that have medium texture and that formed in material weathered from sandstone or limestone.

The soil material has moderate permeability, very low available water capacity, and low natural fertility. Runoff is rapid.

The main limitations are rock outcrop and very shallow and shallow soils. Other limitations are steepness of slope, water erosion, soil blowing, and droughtiness.

This land type is not suitable for cultivation, because it is steep, rocky, droughty, and erodible. The very shallow and shallow soils are better suited to grass. Generally, areas are suitable as habitat for wildlife and for use as recreational areas. Grazing needs to be carefully controlled to avoid erosion. Such management practices as a planned grazing system and a proper stocking rate are important if the grasses are to remain healthy and vigorous.

CAPABILITY UNIT VIIs-4, DRYLAND

Only Gravelly land complex, 3 to 30 percent slopes, is in this unit. Areas of this land type are on uplands. Sand and gravel, at or near the surface, make up 50 to 75 percent of the acreage; shallow soils over sand and gravel make up 15 to 25 percent; and deep sand soils make up 10 to 20 percent.

The soil material is excessively drained and has very rapid permeability. The available water capacity and organic-matter content are very low. Natural fertility is low. Runoff is very slow.

Soil blowing is the main limitation. Areas are droughty, and plant cover is difficult to maintain.

This land type is not suitable for growing cultivated crops. It is suited only to grass, to development of habitat for wildlife, and to use as recreational areas. It produces only a small amount of vegetation. Carefully controlled grazing is needed to improve the grass stand and prevent deterioration of the range condition.

CAPABILITY UNIT VIIw-7, DRYLAND

Only Sandy alluvial land is in this unit. Areas of this land type consist of nearly level streambeds and the adjacent nearly level to gently sloping, channeled and hummocky flood plains. Areas are dry during most of the year, but they are flooded after heavy rains. The material in the streambeds is stratified sand of various sizes, and the material on the flood plains is sandy loam, loamy sand, and sand.

The soil material has rapid and very rapid permeability and low or very low available water capacity. The organic-matter content is very low, and natural fertility is low. Runoff is very slow.

Frequent flooding early in spring is the main limitation. Soil blowing is also a limitation. In midsummer, when rainfall is lowest, plants commonly die from lack of sufficient moisture.

This land type is better suited to grass and to use as pasture for livestock than to most other uses. It produces a limited amount of food and cover for wildlife.

CAPABILITY UNIT VIIIw-7, DRYLAND

This unit consists of Marsh and Riverwash. Areas are on bottom lands and have water on or above the surface most of the year or are flooded several times a year by water from overflowing streams. The soil material is stratified and mottled and ranges from clay to sand in texture.

Such properties as permeability, available water capacity, and organic-matter content are variable and are not particularly important to management. Runoff is very slow or ponded.

Excessive wetness is the principal limitation to the use of these areas.

Areas of this unit are not suited to the cultivated crops, to grasses, or to trees, but they are suited to habitat for wildlife and to use as recreational areas. Livestock use very little of the vegetation.

Management of irrigated soils

Many of the management practices discussed for dryland soils are also applicable to irrigated soils. Irrigated soils generally require more fertilizer than dryland soils because the plant population on irrigated soils is generally higher. For nonlegume crops, nitrogen fertilizer is beneficial on all the soils. Phosphorus and zinc are needed on the more eroded soils or on cut areas after construction of terraces or contour benches.

Land leveling increases the efficiency of irrigation because an even distribution of water can be obtained. Efficiency of irrigation water in a furrow system can be much improved by addition of a re-use irrigation system. Sprinkler irrigation is most satisfactory on lighter textured soils where an adequate amount of water is available.

Management is needed to help control erosion on all very gently sloping and gently sloping irrigated soils. Applications of irrigation water in addition to natural rainfall increase erosion; therefore the method of irrigation, the rate of water application, and the time of irrigation are important. A correctly designed system that minimizes soil loss and obtains the best efficiency in the use of irrigation water is needed. On nearly level soils, the furrow system is most commonly used for row crops and the border system is used for hay crops. Soils that have slopes of 1 to 3 percent can be leveled to reduce the grade of flow of the irrigation water. Contour bench leveling and contour irrigation, supplemented by terraces, are alternative systems. If irrigation is desired on gently sloping soils, the sprinkler system is best suited.

The use of terraces combined with farming on the contour help to control erosion on gently sloping soils. Close-growing crops, such as alfalfa and small grain, tend to hold the soil in place better than row crops. Plowing under green-manure crops, adding barnyard manure, and using a stubble-mulch system of cultivation all help to control erosion and soil blowing. These practices are beneficial on such soils as Coly-Uly silt loams, 3 to 9 percent slopes, eroded, and Holdrege silt loam, 3 to 6 percent slopes.

Farmers who need technical help in planning irrigation developments can contact the local office of the Soil Conservation Service or the county agricultural agent. Information about costs and equipment can be obtained from equipment dealers.

Those crops presently irrigated are well suited to the climate and soils of the county and are readily marketable. Bench leveling increases the potential for irrigation on gently sloping, silty soils. Sprinklers can be used on some uneven soil areas, and their use is increasing. The total acreage of irrigated soils in the county has been steadily increasing during the past 30 years, and this trend is likely to continue for a few years.

The following paragraphs describe the capability units for irrigated soils. Each unit includes soils that have similar management requirements, soil hazards, limitations, and concerns in management. Suitable practices to help overcome the soil limitations are given. The names of all the soils in each capability unit are given in the Guide to Mapping Units.

All soils in Nebraska are placed in Irrigation Design Groups, described in the Irrigation Guide for Nebraska. Arabic numbers in the irrigation capability unit indicate the design group to which the soils in the unit belong. For example, capability unit IIe–6, irrigated, indicates that the soils are in design group 6 in the Irrigation Guide. A copy of the Guide is in each field office of the Soil Conservation Service in Nebraska.

CAPABILITY UNIT I–2, IRRIGATED

Only Detroit silt loam, 0 to 1 percent slopes, is in this unit. This is a moderately well drained soil. The surface layer is silt loam, and the subsoil is silty clay. The underlying material is silt loam.

The soil has slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. This soil is easy to work. Runoff is slow.

Crops on this soil respond well to irrigation. Maintaining high fertility is a major concern in management. Soil blowing is a slight hazard where the surface is not adequately protected.

This soil is suited to all types of irrigation. It is suited to corn, sorghum, and alfalfa and to tame grasses for hay and pasture. Slight irregularities in the land surface can make uniform distribution of irrigation water difficult. In most places, slight leveling is needed for gravity irrigation. Leaving crop residue on the surface in winter helps to control blowing.

CAPABILITY UNIT I–4, IRRIGATED

This unit consists of deep, nearly level, well drained and moderately well drained soils on uplands and stream terraces. The surface layer is silt loam, and the subsoil is silt loam, silty clay loam, or light silty clay. The underlying material is silt loam.

These soils have moderate or moderately slow permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. These soils absorb moisture easily and release it readily to plants. They are easy to work. Runoff is slow.

These soils are well suited to irrigated crops. The principal concern in management is maintaining a high level of fertility. Soil blowing is a slight hazard in places where the surface is not protected.

These soils are suited to irrigated corn, sorghum, and alfalfa. In most areas some leveling is needed for gravity irrigation. An efficient irrigation system, uniform distribution of irrigation water, and control of irrigation water are needed on these soils. Pits can be used to trap excess irrigation water for re-use (fig. 16).

CAPABILITY UNIT I–6, IRRIGATED

This unit consists of deep, nearly level, moderately well drained or well drained soils on uplands, stream terraces, and bottom lands. The surface layer and transitional layer, or subsoil, are silt loam. The underlying material is silt loam, sandy loam, or very fine sandy loam.

These soils have moderate permeability and high available water capacity. The organic-matter content is moderate or moderately low, and natural fertility is high. These soils absorb moisture easily and release it readily to plants. They are easy to work. Runoff is slow.

These soils have very few limitations when they are irrigated. The principal concern in management is maintaining a high level of fertility. Soil blowing is a slight hazard where the surface is not adequately protected.

These soils are suited to all types of irrigation. They are suited to corn, sorghum, and alfalfa and to tame grasses for hay and pasture. Slight irregularities in the land surface can make uniform distribution of irrigation water difficult. In most places leveling is needed for gravity irrigation. Leaving crop residue on the surface in winter helps to control soil blowing.

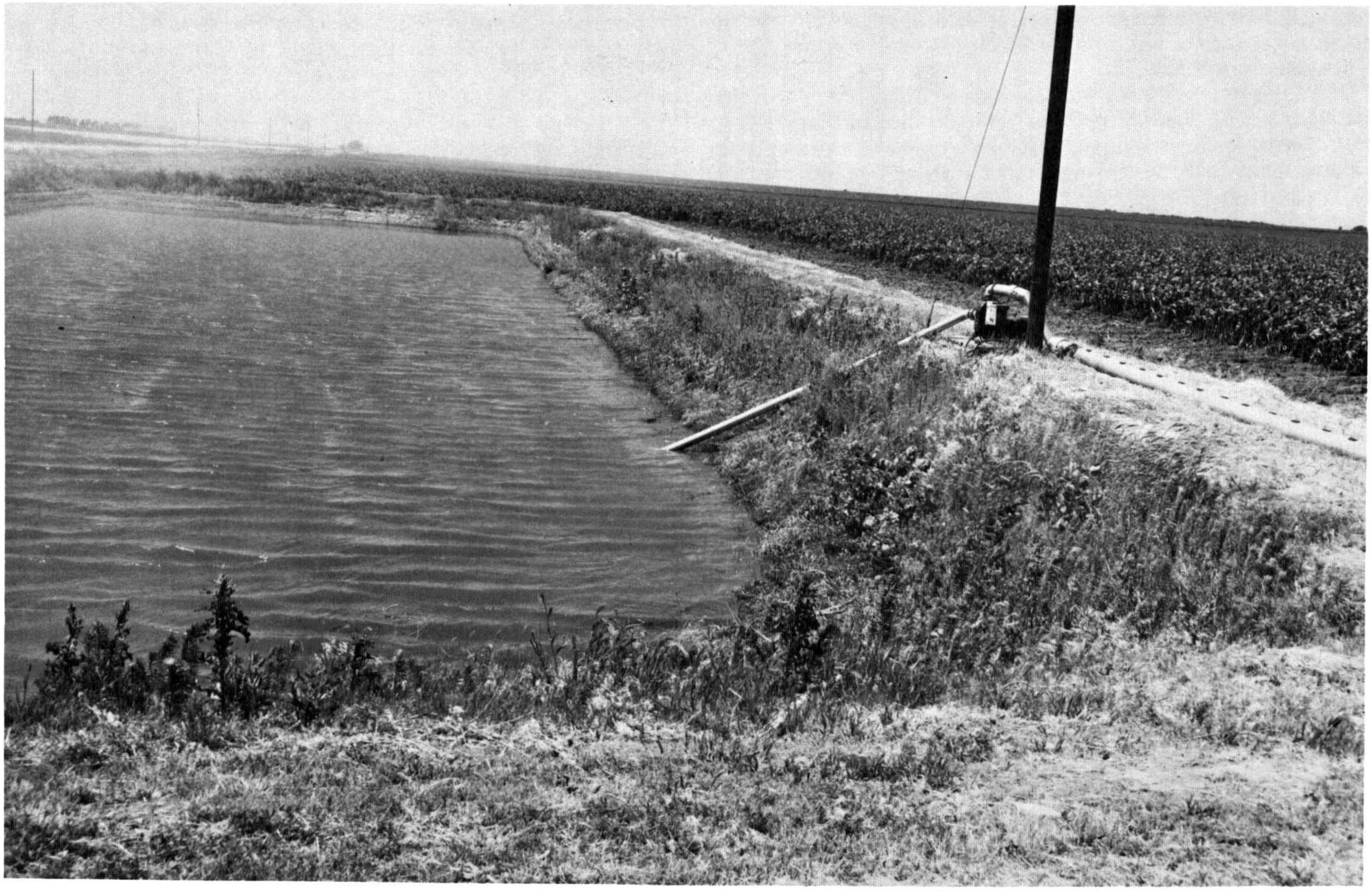

Figure 16.—**This pit traps excess irrigation water for re-use.**

Sustained production can be obtained by using fertilizer, high plant populations, a conservation tillage method of planting row crops that leaves most of the crop residue on the surface, and a water management system that controls the amount and time of application. Uniform distribution of irrigation water and use of measures to reduce and control irrigation water are important (fig. 17).

CAPABILITY UNIT IIe-4, IRRIGATED

Only Holdrege silt loam, 1 to 3 percent slopes, is in this unit. This is a deep, well drained soil on uplands. The surface layer is silt loam, and the subsoil is silty clay loam and silt loam. The underlying material is silt loam.

This soil has moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. This soil absorbs moisture easily and releases it readily to plants. This soil is easy to work. Runoff is medium.

Water erosion is the principal hazard when this soil is irrigated. Soil blowing is a slight hazard when the surface is bare. Maintaining high fertility and good tilth are concerns in management.

Corn, sorghum, alfalfa, and tame grasses are suited to this soil. Gravity or sprinkler irrigation is suited. If furrow irrigation is used, land leveling is needed in almost all areas. For efficient distribution of irrigation water and to protect the soil from water erosion when using a gravity system, contour bench leveling is required, contour furrow leveling and use of terraces on the steepest slopes are needed, and control of irrigation runoff at the end of the field is generally needed. A conservation tillage method of planting row crops that leaves crop residue on the surface is effective in reducing water erosion and soil blowing. A re-use system of pumping the irrigation water back to the upper end of the field will improve the efficiency of irrigation on these soils.

CAPABILITY UNIT IIe-5, IRRIGATED

Only McCook fine sandy loam, 0 to 2 percent slopes, is in this unit. This is a deep, nearly level, well drained soil on bottom lands. The surface layer is fine sandy loam. The transition layer is silt loam. The underlying material is a very fine sandy loam or sandy loam.

This soil has moderate permeability and high available water capacity. The organic-matter content is moderately low. Natural fertility is high. This soil absorbs moisture easily and releases it readily to plants. It is easy to till. Runoff is slow. Intake rate of moisture is moderately high.

Soil blowing is the principal limitation when this soil is irrigated. Maintaining fertility and conserving

Figure 17.—**Siphon tubes transfer irrigation water from an open ditch on Hord silt loam, terrace, 0 to 1 percent slopes.**

moisture are important concerns in management. Phosphate is not readily available to crops, because the soil is calcareous.

This soil is well suited to corn, sorghum, small grain, and alfalfa. The organic-matter content can be maintained by including small grain and legumes in the cropping system and by leaving crop residue on the surface. Furrow and sprinkler irrigation are suited. Land leveling is generally needed for furrow irrigation if water is to be efficiently used. A conservation tillage system of planting row crops that leaves crop residue on the surface can be used to control soil blowing and water erosion. Barnyard manure and commercial fertilizers help to maintain fertility and improve tilth.

CAPABILITY UNIT IIe-6, IRRIGATED

This unit consists of deep, very gently sloping, well drained soils on uplands and stream terraces. The surface layer, subsoil, and underlying material are silt loam.

These soils have moderate permeability and high available water capacity. The organic-matter content is moderate or moderately low, and natural fertility is high. Moisture is absorbed easily and released readily to plants. These soils work easily. Runoff is slow.

The main hazard on these soils is water erosion. Soil blowing is a slight hazard where the soil surface is barren or not adequately protected.

Corn, sorghum, alfalfa, and grass are suited to these soils if they are irrigated. Gravity or sprinkler irrigation is suited. Where a gravity system is used, land leveling helps to insure an even distribution of irrigation water. Leveling for contour furrows and use of terraces and contour benches help to control erosion. A conservation tillage method of planting row crops that leaves the residue on the surface is an effective way to control soil blowing and water erosion. Reducing and controlling irrigation runoff at the end of the fields is a good water conservation practice. Commercial fertilizers and barnyard manure are needed to help maintain fertility.

CAPABILITY UNIT IIe-8, IRRIGATED

Only Munjor fine sandy loam, 0 to 2 percent slopes, is in this unit. This is a deep, nearly level, well drained soil on bottom lands. The surface layer is fine sandy loam. The underlying material is sandy loam in the upper part and sand in the lower part.

This soil has moderately rapid permeability and moderate available water capacity. The organic-matter content is low. Natural fertility is medium. This soil absorbs moisture easily and releases it readily to plants. It is easy to till. Runoff is slow. Intake rate is moderate.

Soil blowing is the main limitation when this soil is irrigated. Maintaining fertility and conserving moisture are important concerns in management. Phosphate is not readily available to crops, because this soil is calcareous.

This soil is well suited to corn, sorghum, small grain, and alfalfa. The organic-matter content can be maintained by including small grain and legumes in the cropping system and by leaving crop residue on the surface. Furrow or sprinkler irrigation is suited. Length of run in this soil is less than in soils where the underlying material is silty. This is because the underlying material has moderately rapid permeability. Land leveling is generally needed for furrow irrigation if water is to be efficiently used. A conservation tillage system of planting row crops that keeps crop residue on the surface can be used to control soil blowing and water erosion. Barnyard manure and commercial fertilizer help to maintain fertility and improve tilth.

CAPABILITY UNIT IIw-2, IRRIGATED

Only Butler silt loam, 0 to 1 percent slopes, is in this unit. This is a deep, somewhat poorly drained soil on uplands. The surface layer is silt loam, and the subsoil is clay, silty clay, and silty clay loam.

This soil has slow permeability because of the claypan of subsoil. The organic-matter content is moderate, and natural fertility is high. The surface layer absorbs moisture at a moderate rate, but the subsoil absorbs it slowly. Moisture is released slowly to plants. This soil is easily tilled. Runoff is very slow, and there is some ponding in places.

Excessive wetness after rains is a limitation, because this soil dries slowly. Tillage is delayed longer in spring than for soils that have better surface drainage.

Irrigated crops suited to this soil are corn, sorghum, and alfalfa and grass for hay or pasture. Land leveling is needed if furrows and borders are used. Leveling improves water distribution and surface drainage. Furrow irrigation is well suited because water is not lost by downward movement through the clayey subsoil. Commercial fertilizers and barnyard manure help to maintain fertility.

CAPABILITY UNIT IIw-6, IRRIGATED

This unit consists of deep, nearly level, somewhat poorly drained or moderately well drained soils on bottom lands. The surface layer is silt loam and silty clay loam. The transition layer and underlying material are silt loam or very fine sandy loam. These soils have a water table that fluctuates between the depths of 2 and 6 feet, or they are flooded an average of once or twice a year. The flooding is of short duration.

These soils have moderately slow or moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high. These soils are easy to till, except when they are too wet.

Because of the seasonal high water table or the occasional flooding, wetness is the principal concern in management. The wetness delays tillage in spring. Crops are sometimes damaged by flooding, but a total crop loss is uncommon.

The irrigated crops suited to these soils are corn and sorghum and tame grasses for hay or pasture. Sprinkler or gravity irrigation is suited if areas are large enough. Land leveling is needed if gravity irrigation is used. Leveling improves the surface drainage as well as the efficiency of irrigation water. Grass in the cropping system improves the organic-matter content of these soils. In some areas drainage ditches or tile drains can be used to lower the water table, so that tillage can be more timely in spring.

CAPABILITY UNIT IIw-8, IRRIGATED

This unit consists of deep, nearly level, somewhat poorly drained soils on bottom lands. The surface layer is fine sandy loam or silt loam, and the underlying material is sandy loam. In some areas, loamy sand that contains about 10 percent gravel is in the lower part of the underlying material. These soils have a water table that fluctuates between the depths of 2 and 6 feet. They are calcareous.

These soils have moderately rapid permeability and moderate available water capacity. The organic-matter content is moderately low, and natural fertility is medium. These soils absorb moisture easily and release it readily to plants. They are easy to till. Runoff is slow.

The main limitation is wetness caused by the seasonal high water table. Wetness is most common in spring when the water table is highest and rainfall is heaviest. These soils warm more slowly than soils that are better drained. Tillage is commonly delayed by the wetness. Soil blowing is a limitation where the surface layer is not protected from the wind. Much of the phosphate is not available to crops because these soils are calcareous.

Irrigated crops best suited to these soils are corn, sorghum, and tame grasses. Alfalfa can also be grown. Gravity or sprinkler irrigation is suited on these soils. Small, frequent applications of irrigation water are needed. In some areas drainage ditches or tile drains can be used to lower the water table so that tillage can be more timely in spring. Fertilizer and barnyard manure can be used to maintain fertility. Phosphate fertilizer is needed in places, especially for legume crops.

CAPABILITY UNIT IIIe-4, IRRIGATED

This unit consists of deep, gently sloping, well drained soils on uplands. The surface layer is silt loam. The subsoil is silt loam and silty clay loam, and the underlying material is silt loam.

These soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high or medium. These soils absorb moisture easily and release it readily to plants. They are easily tilled. Runoff is medium.

Because of the steepness of slope, water erosion is the main limitation if these soils are irrigated. Soil blowing is a limitation where the surface is not protected from the wind.

Corn, sorghum, alfalfa, and grass are suited to these soils. Terraces, contour furrow irrigation, grassed waterways, and contour bench leveling (fig. 18), help to control water erosion. Sprinkler irrigation can be used where erosion is controlled. A system of conservation tillage that keeps crop residue on the surface and helps to control water erosion and soil blowing is desirable. Soil fertility can be improved by using commercial fertilizers and barnyard manure.

CAPABILITY UNIT IIIe-6, IRRIGATED

This unit consists of deep, gentlv sloping well

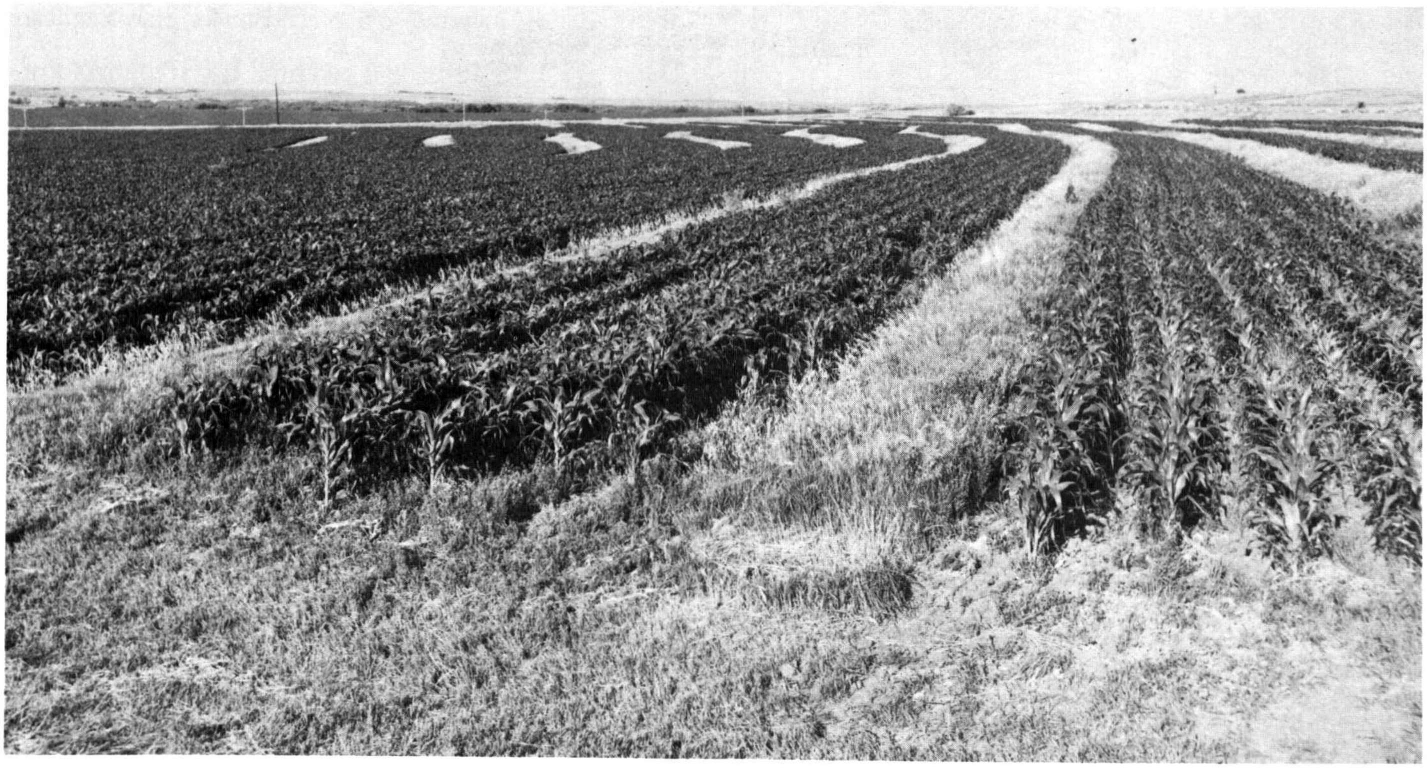

Figure 18.—Contour bench leveling on Holdrege silt loam, 3 to 6 percent slopes.

drained soils on uplands. The surface layer, subsoil, and underlying material are silt loam.

These soils have moderate permeability and high available water capacity. The organic-matter content is moderately low, and natural fertility is high and medium. These soils absorb moisture easily and release it readily to plants. They are easily tilled. Runoff is medium.

Because of the slope, water erosion is the principal limitation when these soils are irrigated. Soil blowing is a slight hazard where the surface is left bare and unprotected from the wind.

Irrigated corn, sorghum, alfalfa, and grass are suited to these soils. Because of the hazard of water erosion, row crops should only be irrigated if such erosion control practices as terraces, contour bench leveling, contour furrows, waterways, and conservation tillage are used. Sprinkler irrigation is suitable for row crops if these erosion control practices are used. A conservation tillage system that keeps crop residue on the surface is desirable. Soil fertility can be improved by using commercial fertilizers and barnyard manure.

CAPABILITY UNIT IIIe-8, IRRIGATED

Only Hersh-Valentine complex, 1 to 6 percent slopes, is in this unit. These are deep, well drained and excessively drained soils on hummocky uplands. The surface layer is fine sandy loam or loamy sand. The transition layer and underlying material are sandy loam or fine sand.

These soils have moderately rapid or rapid permeability and moderate or low available water capacity. The organic-matter content is low or very low, and natural fertility is medium or low. Moisture is easily absorbed by these soils and is released readily to plants. These soils are easy to till. Runoff is medium.

Water erosion and soil blowing are the main limitations if these soils are irrigated. Conservation of water is a concern in management, because these soils have moderately coarse texture and coarse texture and, in places, have excessive loss of moisture. Excessive water can leach plant nutrients to a depth below the root zone of crops.

Corn, sorghum, alfalfa, tame grasses, and small grain are suited to this soil. Because of the coarse texture of the soil, sprinkler irrigation is more suitable than gravity irrigation. For row crops under sprinkler irrigation, conservation tillage that leaves crop residue on the surface is needed to help control water erosion and soil blowing. Soil fertility can be improved by using commercial fertilizers and barnyard manure. Managing irrigation water so that frequent but small amounts are applied is most effective.

CAPABILITY UNIT IIIe-10, IRRIGATED

Only Munjor loamy fine sand, 0 to 2 percent slopes, is in this unit. This is a deep, well drained soil on bottom lands. The surface layer is loamy fine sand. The subsoil and underlying material are sandy loam. In some areas coarse and medium sand are in the lower part of the underlying material. This soil is calcareous at the surface.

This soil has moderately rapid permeability and moderate available water capacity. The organic-matter content is low, and natural fertility is medium. Moisture enters this soil rapidly and is released readily to plants. Runoff is slow. Tillage is easy, but the surface layer is loose when dry.

Soil blowing is the main limitation. Improving fertility and increasing the organic-matter content are important concerns in management. Phosphate is not readily available to crops, because the soil is calcareous.

Under irrigation this soil is suited to corn, sorghum, alfalfa, and small grain and to tame grasses for hay and pasture. Sprinkler or gravity irrigation is suited. For gravity irrigation, some land leveling is generally needed to improve the efficiency of surface water movement. Shorter runs are also needed, because some water is commonly lost by deep percolation through the soil. A conservation tillage system of planting row crops that leaves crop residue on the surface helps to control soil blowing and water erosion. Soil fertility can be improved by using commercial fertilizers and barnyard manure. Phosphate fertilizer is needed in places, especially for legume crops.

CAPABILITY UNIT IIIe-11, IRRIGATED

This unit consists of deep, nearly level and very gently sloping, excessively drained soils on bottom lands. The surface layer is loamy sand or fine sandy loam. The transition layer is loamy sand, and the underlying material is fine sand.

These soils have rapid permeability and low available water capacity. The organic-matter content and natural fertility are low. Water enters these soils easily. Tillage is easy, but the surface layer is loose in places when dry. Runoff is very slow.

Soil blowing is the main limitation to the use of these soils. Conservation of moisture is a major concern in management because of the low available water capacity and rapid permeability. Improving the organic-matter content and increasing the level of fertility are also concerns. Plant nutrients can be leached through the profile if excessive water is applied.

Alfalfa, grass for hay and pasture, and small grain are suited to these soils. Sprinkler irrigation is generally better suited to these soils than the gravity system because of the rapid permeability and because frequent, small applications of water are needed. A conservation system of tillage that leaves crop residue on the surface helps to control soil blowing. Fertility can be improved by using commercial fertilizers and barnyard manure.

CAPABILITY UNIT IIIw-2, IRRIGATED

Only Fillmore silt loam, 0 to 1 percent slopes, is in this unit. This is a deep, poorly drained soil in depressions on uplands. The surface layer is silt loam, the subsoil is silty clay, and the underlying material is silt loam. Water ponds on this soil after heavy rains.

This soil has very slow permeability because of the claypan subsoil. Available water capacity is high. The organic-matter content is moderate, and natural fertility is high. This soil absorbs moisture slowly and releases it slowly to plants. Tillage is delayed in spring when rainfall is highest.

The principal limitation is ponding of water that runs on from the higher lying soils. The water that ponds is not deep and generally remains for only a short time. Soil blowing is a limitation in places where the soil is left bare.

Under irrigation this soil is suited to corn, sorghum, alfalfa, grass for hay or pasture, and small grain. Land leveling improves surface drainage so that furrow irrigation can be used. Returning crop residue to the soil helps to maintain tilth and improves organic-matter content. Fertility can be maintained by using commercial fertilizers and barnyard manure. Diversions and terraces can be constructed on the adjacent, higher soils to help prevent excess water from inundating areas of this soil.

CAPABILITY UNIT IVe-3, IRRIGATED

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

These soils have moderate permeability and high available water capacity. The organic-matter content and natural fertility are low. These soils absorb moisture easily and release it readily to plants. Workability is somewhat difficult because, in places, the surface layer is firm. Runoff is medium.

The main limitation to the use of these soils is water erosion. Soil blowing is a slight hazard. Concerns in management are improving the fertility and increasing the organic-matter content of the soil.

Irrigated corn, sorghum, alfalfa, grass for hay and pasture, and small grain are suited if erosion control practices are applied. Because of water erosion, row crops should be irrigated only if such erosion control practices as terraces, contour bench leveling, contour furrows, waterways, and conservation tillage are used. Sprinkler irrigation is suited for row crops where adequate erosion control practices are applied. A system of conservation tillage that leaves crop residue on the surface helps to control erosion where sprinkler irrigation is used. Soil fertility can be improved by using commercial fertilizers and barnyard manure. Phosphate and zinc fertilizers are needed in eroded areas of these soils.

CAPABILITY UNIT IVe-4, IRRIGATED

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

These soils have moderate permeability and high available water capacity. The organic-matter content is moderate, and natural fertility is high or medium. These soils absorb moisture easily and release it readily to plants. They are easy to work. Runoff is medium.

Water erosion is the main limitation if these soils are irrigated. Soil blowing is a slight hazard. Maintaining fertility is particularly important.

Because of the steepness of these soils, alfalfa and grass for hay and pasture are the most suitable crops. Small grain can also be grown. Row crops need a high level of management to prevent erosion by water. Sprinkler or gravity irrigation can be used for row crops if erosion control practices are applied. Contour furrows, contour bench leveling, grassed waterways, and a conservation system of tillage that leaves crop residue on the surface are suitable practices to help control erosion. Soil fertility can be improved by using commercial fertilizers and barnyard manure.

CAPABILITY UNIT IVe-6, IRRIGATED

This unit consists of deep, gently sloping and strongly sloping, somewhat excessively drained or well drained soils on uplands. The surface layer, subsoil, and underlying material are silt loam. Many areas are calcareous at the surface, and many areas are eroded.

These soils have moderate permeability and high available water capacity. The organic-matter content is moderately low or low. These soils absorb moisture easily and release it readily to plants. They are easy to till. Runoff is medium.

The main limitation is water erosion. Soil blowing is a limitation where the surface layer is not adequately protected. Concerns in management are increasing the fertility and the organic-matter content. Phosphate is not readily available where the surface layer is calcareous.

Because of erosion on these soils, row crops need intensive conservation practices such as terraces, grassed waterways, contour furrows and contour bench leveling along with a conservation tillage system that leaves crop residue on the surface. Using a cropping system that includes grass and close growing crops also helps to maintain the organic-matter content and keeps crop residue on the surface. Soil fertility can be maintained and improved by using commercial fertilizers and barnyard manure.

CAPABILITY UNIT IVe-8, IRRIGATED

Only Hersh-Valentine complex, 6 to 11 percent slopes, is in this unit. These are deep, well drained or excessively drained soils on hummocky uplands. The surface layer is fine sandy loam or loamy sand. The transition layer is sandy loam or fine sand, and the underlying material is sandy loam or fine sand.

These soils have moderately rapid or rapid permeability and moderate or low available water capacity. The organic-matter content is low or very low, and natural fertility is medium or low. Moisture enters these soils easily and is released readily to plants. The soils are easy to till. Runoff is medium.

Soil blowing and water erosion are the main limitations if these soils are irrigated. Maintaining and increasing fertility and organic-matter content are concerns in management. Excessive use of irrigation water can leach plant nutrients to a depth below the roots of crops.

Because of the moderately high water intake rate of these soils, sprinkler irrigation is better suited than gravity irrigation. Water should be frequently applied in small amounts. A conservation tillage system of planting row crops and leaving crop residue on the surface is very effective in helping to control soil blowing. Including grass in the cropping system maintains and increases the organic-matter content. Soil fertility can be improved by using commercial fertilizers and barnyard manure.

Predicted yields

Predicted acre yields for principal crops grown in Franklin County are shown in table 2. These predictions are based on average yields for seeded crops over the most recent 5-year period. They do not anticipate yields that might be obtainable in the future under a new technology.

Yields for the various crops were derived from information obtained from interviews with farmers, directors of the Natural Resource Districts, representatives of the Soil Conservation Service and the Cooperative Extension Service, and others familiar with the soils and farming in the county. Yield information from the Agriculture Stabilization and Conservation Service and research data from the Agricultural Experiment Station were also used. Yield records, farm trends, research information, and experience were taken into consideration.

Crop yields are influenced by many factors. Some soil features affecting yields are depth, texture, slope, and drainage. Also important are erosion, available water capacity, permeability, and fertility. Management practices such as the pattern of cropping, timing of operations, population of plants, and variety of crops affect crop yields. Fluctuations in weather are also significant, both on a day to day basis and on a seasonal or yearly basis. All of these factors were taken into account when table 2 was prepared.

The yields listed are those expected under a high level of management. Under a high level of management, fertility is maintained and fertilizer and lime is applied at rates indicated by soil tests and field experiments; crop residue is incorporated into the soil to improve tilth and to maintain or increase organic matter content; suitable varieties of seed are used, and plant populations are optimum; and weeds, insects, and diseases are well controlled. Also, under a high level of management, conservation practices that help to control water erosion and soil blowing are used; where drainage is needed for crop production, the soil is drained; tillage and seeding are timely and adequate; the soil is protected from deterioration and used in accordance with its capacity; and irrigation water is applied in a timely manner and in the proper amounts.

One of the best uses for table 2 is to compare the yields of a soil to other soils in the county. The table gives no recommendations, and the yields shown do not apply to specific farms or farmers.

Yields in any one year on a particular soil can vary considerably from the figures given. This is because of the effects of weather, sudden infestations of diseases, insects, or other unpredictable hazards. By using long-time averages, it is possible to consider such hazards in predicting crop yields.

Improved technology may make predictions in the table obsolete in a few years. Yield data will then need to be updated as knowledge is gained and improvements in technology show the need.

Range [3]

Range makes up approximately 43 percent of the acreage in Franklin County. It is scattered throughout the county, but it is mainly along the Republican River. It is generally not suited to cultivation. The

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

TABLE 2.—*Predicted average acre yields of principal dryfarmed and irrigated crops*

[Yield predictions are for a high level of management. Absence of a figure indicates the soil is not suited to the crop or that the crop is not grown extensively]

Soil	Corn		Grain sorghum		Wheat	Alfalfa hay	
	Dryfarmed	Irrigated	Dryfarmed	Irrigated	Dryfarmed	Dryfarmed	Irrigated
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*
Broken alluvial land							
Butler silt loam, 0 to 1 percent slopes	46	135	55	110	33	2.7	6.0
Campus complex, 9 to 30 percent slopes							
Canyon-Campus loams, 9 to 30 percent slopes							
Coly-Uly silt loams, 3 to 9 percent slopes, eroded	25		32		23	1.3	5
Coly-Uly silt loams, 9 to 30 percent slopes							
Detroit silt loam, 0 to 1 percent slopes	45	140	53	115	38	2.4	6
Fillmore silt loam, 0 to 1 percent slopes	35		45		22	1.5	
Gibbon silt loam, 0 to 2 percent slopes	56	130	65	115	32	3.5	5.5
Gravelly land complex, 3 to 30 percent slopes							
Hall silt loam, 0 to 1 percent slopes	52	145	61	120	41	2.8	6.5
Hall silt loam, terrace, 0 to 1 percent slopes	50	145	61	120	40	2.7	6.5
Hastings silt loam, 0 to 1 percent slopes	46	140	56	120	40	2.5	6.5
Hersh-Valentine complex, 1 to 6 percent slopes	29	90	38	85	25	1.7	5
Hersh-Valentine complex, 6 to 11 percent slopes	24		31		20	1	4
Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes	60	135	68	110	32	4	6
Holdrege silt loam, 0 to 1 percent slopes	47	145	58	120	40	2.5	6.5
Holdrege silt loam, 1 to 3 percent slopes	44	140	55	115	38	2.3	6.2
Holdrege silt loam, 3 to 6 percent slopes	40	125	50	105	34	2.1	5.8
Holdrege silt loam, 6 to 9 percent slopes	33		41		28	1.7	5
Holdrege and Uly soils, 3 to 9 percent slopes, eroded	30		37		26	1.5	5
Hord silt loam, terrace, 0 to 1 percent slopes	56	145	65	120	43	3.6	6.5

TABLE 2.—*Predicted average acre yields of principal dryfarmed and irrigated crops*—Continued

Soil	Corn		Grain sorghum		Wheat	Alfalfa hay	
	Dryfarmed	Irrigated	Dryfarmed	Irrigated	Dryfarmed	Dryfarmed	Irrigated
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*
Hord silt loam, terrace, 1 to 3 percent slopes	49	140	60	115	40	2.6	6.2
Inavale loamy sand, 0 to 3 percent slopes	25	90	33	80	20	1.2	4
Inavale fine sandy loam, 0 to 3 percent slopes	30	110	40	100	22	1.5	4.5
Kenesaw silt loam, 0 to 1 percent slopes	44	140	55	115	38	2.3	6.1
Kenesaw silt loam, 1 to 3 percent slopes	42	135	53	110	35	2.4	6
Kenesaw silt loam, 3 to 6 percent slopes	34	125	43	105	30	1.9	5.7
Kipson complex, 9 to 30 percent slopes	----	----	----	----	----	----	----
Marsh	----	----	----	----	----	----	----
McCook fine sandy loam, 0 to 2 percent slopes	46	135	55	110	35	2.8	6.2
McCook silt loam, 0 to 2 percent slopes	56	145	68	120	40	3.2	6.5
Munjor loamy fine sand, 0 to 2 percent slopes	30	100	40	95	25	1.8	5
Munjor fine sandy loam, 0 to 2 percent slopes	40	130	51	105	32	2.6	6
Nuckolls-Hobbs complex, 9 to 30 percent slopes	----	----	----	----	----	----	----
Nuckolls and Holdrege silt loams, 3 to 6 percent slopes	37	125	47	105	32	1.9	5.7
Nuckolls and Holdrege silt loams, 6 to 9 percent slopes	29	----	37	----	26	1.6	5
Nuckolls and Holdrege soils, 3 to 9 percent slopes, eroded	27	----	34	----	24	1.4	5
Nuckolls and Meadin soils, 9 to 30 percent slopes	----	----	----	----	----	----	----
Riverwash	----	----	----	----	----	----	----
Rough broken land, loess, 20 to 60 percent slopes	----	----	----	----	----	----	----
Rough stony land, 15 to 30 percent slopes	----	----	----	----	----	----	----
Roxbury silt loam, 0 to 2 percent slopes	58	145	68	120	40	3.2	6.5
Sandy alluvial land	----	----	----	----	----	----	----
Scott silt loam, 0 to 1 percent slopes	15	----	30	----	15	----	----

TABLE 2.—*Predicted average acre yields of principal dryfarmed and irrigated crops*—Continued

Soil	Corn		Grain sorghum		Wheat	Alfalfa hay	
	Dryfarmed	Irrigated	Dryfarmed	Irrigated	Dryfarmed	Dryfarmed	Irrigated
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Tons*	*Tons*
Uly silt loam, 3 to 6 percent slopes	35	125	47	105	30	2	5.7
Uly silt loam, 6 to 11 percent slopes	30		38		26	1.6	4.8
Valentine loamy sand, hilly							
Valentine-Hersh complex, 11 to 30 percent slopes							
Wann fine sandy loam, 0 to 2 percent slopes	50	130	60	110	30	3.4	5.8
Wann silt loam, 0 to 2 percent slopes	54	135	63	115	35	3.6	6

major soil associations in range are the Nuckolls-Holdrege-Uly association and the Nuckolls-Holdrege-Campus association.

The raising of livestock, mainly cow and calf herds from which the calves are sold as feeders in fall, is the second largest farming enterprise in the county. The livestock generally graze range from late in spring to early in fall, graze grain sorghum (milo) or corn aftermath in fall, and are fed hay or silage, or both, during winter.

Management and improvement practices

Management practices that maintain or improve range condition are needed on all rangeland, regardless of other practices used. Such practices are proper grazing use, deferred grazing, and planned grazing systems. The proper distribution of livestock on rangeland can be improved by the correct location of fences, livestock water developments (fig. 19), and salting facilities. Range seeding improves range condition. This is the establishment of native grasses, either wild harvest or improved strains, by seeding or reseeding on land suitable for use as range. For example, such soils as Nuckolls and Holdrege soils, 3 to 9 percent slopes, eroded, that are in crops should be range seeded (fig. 20). The most important grasses used in the seed mixture are big bluestem, little bluestem, indiangrass, switchgrass, side-oats grama, and blue grama.

Range plants

Following is a list of names of plants that are used in this soil survey. Most of these plants are mentioned in the descriptions of the range sites.

Common name	*Scientific name*
Arkansas rose	*Rosa arkansana* Porter.
Baldwin ironweed	*Veronia baldwini* Torr.
Big bluestem	*Andropogon gerardi* Vitman.
Blue grama	*Bouteloua gracilis* (H.B.K.) Lag. ex. Steud.
Blue verbena	*Verbena hastata* L.
Broom snakeweed	*Gutierrezia sarothrae* (Pursh) Britt. and Rusky.
Buffalograss	*Buchloe dactyloides* (Nutt.) Engelm.
Canada wildrye	*Elymus canadensis* L.
Common pricklypear	*Opuntia compressa* (Salish.) Macbr.
Common ragweed	*Ambrosia artemisifolia* L.
Cottonwood	*Populus deltoides* var. *occidentalis* Rydb.
Curlycup gumweed	*Grindelia squarrosa* (Pursh) Denal.
Dandelion	*Taraxacum officinale* Weber in Wiggers.
Foxtail barley	*Hordeum jubatum* L.
Green muhly	*Muhlenbergia racemosa* (Michx.) B.S.P.
Hairy grama	*Bouteloua hirsuta* Lag.
Indiangrass	*Sorghastrum nutans* (L.) Nash.
Kentucky bluegrass	*Poa pratensis* L.
Little bluestem	*Andropogon scoparius* Michx.
Needleandthread	*Stipa comata* Trin. and Rupr.
Perennial three-awn	*Aristida* spp. L.
Plains muhly	*Muhlenbergia cuspidata* (Torr.) Rydb.
Prairie cordgrass	*Spartina pectinata* Link.
Prairie junegrass	*Koeleria cristata* (L.) Pers.
Prairie sandreed	*Calamovilfa longifolia* (Hook.) Scribn.
Prairie three-awn	*Aristida oligantha* Michx.
Sand bluestem	*Andropogon hallii* Hack.
Sand dropseed	*Sporobolus cryptandrus* (Torr.) A. Gray.
Sand paspalum	*Paspalum stramineum* Nash.
Sandhill muhly	*Muhlenbergia pungens* Thurb.
Scribner panicum	*Panicum scribnerianum* Nash.
Sedges	*Carex* spp. L.
Side-oats grama	*Bouteloua curtipendula* (Michx.) Torr.
Switchgrass	*Panicum virgatum* L.
Tall dropseed	*Sporobolus asper* (Michx.) Kunth.
Western ragweed	*Ambrosia psilostachya* DC.
Western wheatgrass	*Agropyron smithii* Rydb.
Windmillgrass	*Chloris verticillata* Nutt.
Willows	*Salix* spp. L.

Range sites and condition classes

Different kinds of rangeland produce different kinds and amounts of native grasses. For proper range management, an operator should know the different kinds of land or range sites in his holding and the native

Figure 19.—**A pond used to water livestock and to distribute grazing.**

Figure 20.—**Cattle grazing on planted native grasses in an area of Nuckolls and Holdrege soils, 3 to 9 percent slopes, eroded.**

plants that can grow on each site. Management can then be used that will favor the growth of the desired plants on each kind of land.

Range sites are distinctive kinds of rangeland that differ from each other in their ability to produce a significant difference in kind, proportion, or production of climax vegetation. A significant difference is one that is 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 type of vegetation.

Range condition is classified according to the percentage of vegetation on the site that is original, or climax, vegetation. This classification is used to compare the kind and amount of present vegetation with that which the site can produce. Changes in range condition are caused mainly by the intensity of grazing and by drought.

Climax vegetation may be altered by intensive grazing. Livestock graze selectively. They constantly seek the more palatable and nutritious plants. Plants respond to grazing by decreasing, increasing, or invading. 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* withstand grazing better than decreasers or are less palatable to livestock. They increase under grazing and replace the decreasers. *Invaders* are weeds, normally not present in the climax vegetation, 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 in relation to 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 0 to 25 percent is climax.

Descriptions of the range sites

The range sites in Franklin County are described in this section. Briefly discussed in each site are the topography, a description of the soils, the dominant vegetation on the site when range is in excellent condition and when range is in poor condition, and the total annual production of air-dry herbage, in pounds per acre, in favorable and unfavorable years.

To find the names of all the soils in any given site or the range site of a specified soil, refer to the "Guide to Mapping Units." Marsh, Riverwash, and Scott silt loam, 0 to 1 percent slopes, are not assigned to a range site, because they are generally not used for range.

SUBIRRIGATED RANGE SITE

This site consists of deep, nearly level, somewhat poorly drained soils on bottom lands of the Republican River valley. The surface layer is silty or loamy, and the underlying material ranges from silty to sandy. The kind of vegetation that grows on this site is mainly limited by the water table, which is at a depth of 2 to 6 feet during most of the growing season.

At least 75 percent of the plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, little bluestem, prairie cordgrass, and Canada wildrye. Other perennial grasses and forbs make up the rest. Western wheatgrass, Kentucky bluegrass, and sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of Kentucky bluegrass, foxtail barley, dandelion, blue verbena, cottonwoods, willows, and small amounts of western wheatgrass and members of the sedge family.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 4,500 pounds per acre in unfavorable years to 5,500 pounds in favorable years.

SILTY OVERFLOW RANGE SITE

This site consists of deep, nearly level to very gently sloping, moderately well drained to poorly drained, silty soils and land types on bottom lands. Areas are periodically flooded. Available water capacity is high. The kind of vegetation that grows on this site is mainly limited by flooding, siltation, and the moderate permeability of the soil material.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, switchgrass, indiangrass, little bluestem, prairie cordgrass, and Canada wildrye. Other grasses and forbs make up the rest. Western wheatgrass, side-oats grama, Kentucky bluegrass, green muhly, and various sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of Kentucky bluegrass, western wheatgrass, common ragweed, Baldwin ironweed, and members of the sedge family.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 4,000 pounds per acre in unfavorable years to 5,000 pounds in favorable years.

CLAYEY OVERFLOW RANGE SITE

Only Fillmore silt loam, 0 to 1 percent slopes, is in this site. This soil is poorly drained, is nearly level, and is in depressions on uplands. The surface layer is silt loam, and the subsoil is silty clay. The kind of vegetation that grows on this site is mainly limited by ponding of water and the very slow permeability of the soil.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, switchgrass, prairie cordgrass, indiangrass, little bluestem, and Canada wildrye. Other grasses and forbs make up the rest. Western wheatgrass, Kentucky bluegrass, blue grama, and sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of Kentucky bluegrass, common ragweed, and members of the sedge family.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 2,500 pounds per acre in unfavorable years to 4,000 pounds in favorable years.

SANDY LOWLAND RANGE SITE

This site consists of nearly level or very gently sloping, well drained and excessively drained soils on bottom lands. The surface layer ranges from fine sandy loam to loamy sand, and the underlying material ranges from sandy loam to sand. The water table is below a depth of 5 feet but is generally above a depth of 15 feet. The kind of vegetation that grows on this site is mainly limited by the water table or by minor flooding.

At least 70 percent of the climax plant cover is a mixture of such decreaser grasses as sand bluestem, little bluestem, switchgrass, indiangrass, needleandthread, and Canada wildrye. Other perennial grasses and forbs make up the rest. Prairie sandreed, blue grama, sand dropseed, Scribner panicum, western wheatgrass, and sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of sand dropseed, blue grama, Scribner panicum, western ragweed, and members of the sedge family.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 3,000 pounds per acre in unfavorable years to 4,000 pounds in favorable years.

SILTY LOWLAND RANGE SITE

This site consists of nearly level and very gently sloping, well drained or moderately well drained soils on uplands, stream terraces, and bottom lands. Areas receive runoff from higher elevations. The surface layer is silt loam or fine sandy loam, and the subsoil ranges from silt loam to silty clay loam. Permeability is moderate to slow. The kind of vegetation that grows on this site is mainly affected by the additional moisture that is received as runoff from higher areas.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, indiangrass, switchgrass, little bluestem, and Canada wildrye. Other grasses and forbs make up the rest. Western wheatgrass, side-oats grama, blue grama, Kentucky bluegrass, and sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of Kentucky bluegrass, western wheatgrass, blue grama, common ragweed, and members of the sedge family.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 3,500 pounds per acre in unfavorable years to 4,500 pounds in favorable years.

SANDS RANGE SITE

This site consists of nearly level to steep, excessively drained, sandy soils and land types on uplands and bottom lands. The surface layer and underlying material are loamy sand or fine sand. Fertility is low, and runoff is slow. The kind of vegetation that grows on this site is mainly affected by the rapid permeability and the low available water capacity of the soils.

At least 75 percent of the climax plant cover is a mixture of such decreaser grasses as sand bluestem, little bluestem, switchgrass, and prairie junegrass. Other perennial grasses, forbs, and shrubs make up the rest. Prairie sandreed, needleandthread, blue grama, sand dropseed, and various sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of blue grama, sand dropseed, sand paspalum, and western ragweed.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 2,000 pounds per acre in unfavorable years to 3,000 pounds in favorable years.

SANDY RANGE SITE

This site consists of deep, very gently sloping to steep, well drained soils on uplands. The surface layer and subsoil range from fine sandy loam to loamy sand. Natural fertility is medium. The kind of vegetation that grows on this site is mainly affected by the moderately rapid permeability and the moderate available water capacity of the soils.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as sand bluestem, little bluestem, switchgrass, indiangrass, and prairie junegrass. Other perennial grasses and forbs make up the rest. Prairie sandreed, needleandthread, blue grama, sand dropseed, and western wheatgrass are the principal increasers. The typical plant community when the site is in poor range condition consists of blue grama, western wheatgrass, sand dropseed, windmillgrass, and western ragweed.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 1,750 pounds per acre in unfavorable years to 3,000 pounds in favorable years.

SILTY RANGE SITE

This site consists of deep, nearly level to steep, moderately well drained to somewhat excessively drained soils on uplands. The surface layer is silt loam, and the subsoil ranges from silt loam to silty clay loam. Natural fertility is medium to high. The kind of vegetation that grows on this site is mainly affected by the silty surface layer and the high available water capacity of the soils.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, indiangrass, and prairie junegrass. Other perennial grasses, forbs, and shrubs make up the rest. Side-oats grama, blue grama, western wheatgrass, sand dropseed, and various sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of blue grama, buffalograss, sand dropseed, perennial threeawns, and western ragweed.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 2,000 pounds per acre in unfavorable years to 3,500 pounds in favorable years.

CLAYEY RANGE SITE

Only Butler silt loam, 0 to 1 percent slopes, is in this site. This soil is deep, nearly level, and somewhat poorly drained. It is on uplands. The surface layer is silt loam, and the subsoil is clay. The available water capacity and natural fertility are high. The vegetation that grows on this site is mainly limited by the slow permeability and the very slow runoff from areas of this soil.

At least 50 percent of the climax plant cover is a mixture of such decreaser grasses as big bluestem, little bluestem, switchgrass, indiangrass, side-oats grama, and prairie junegrass. Other perennial grasses, forbs, and shrubs make up the rest. Blue grama, buffalograss, tall dropseed, western wheatgrass, and members of the sedge family are the principal increasers. The typical plant community when the site is in poor range condition consists of blue grama, buffalograss, Kentucky bluegrass, and western ragweed.

When the site is in excellent range condition, the total annual production of air-dry herbage ranges from 1,500 pounds per acre in unfavorable years to 3,500 pounds in favorable years.

CHOPPY SANDS RANGE SITE

Only Valentine loamy sand, hilly, is in this site. This soil is deep, steep and very steep, and excessively drained. It is on the sandhills. "Catsteps" are common in the areas that are steepest. The surface layer is loamy sand, and the transition layer and underlying material are fine sand. The available water capacity and natural fertility are low. The vegetation that grows on this site is mainly affected by the coarse texture and the steep and very steep slopes.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as sand bluestem, switchgrass, indiangrass, and prairie junegrass. Other perennial grasses, forbs, and shrubs make up the rest. Little bluestem, prairie sandreed, hairy grama, sand dropseed, Arkansas rose, and various sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of blue grama, hairy grama, sand dropseed, sand paspalum, and sandhill muhly.

When the site is in excellent range condition, the annual production of air-dry herbage ranges from 1,500 pounds per acre in unfavorable years to 3,000 pounds in favorable years.

LIMY UPLAND RANGE SITE

This site consists of moderately deep and deep, gently sloping to steep, well drained or somewhat excessively drained soils on uplands. These soils are calcareous at or near the surface and in the underlying material. The surface layer and underlying material are loam or silt loam. Limy sandstone is at a depth of about 25 inches in many areas. The kind of vegetation that grows on this site is affected by the limy surface layer of the soils.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, indiangrass, and switchgrass. Other perennial grasses and forbs make up the rest. Side-oats grama, blue grama, hairy grama, buffalograss, and western wheatgrass are the principal increasers. The typical plant community when the site is in poor range condition consists of blue grama, buffalograss, hairy grama, sand dropseed, western ragweed, blue verbena, and common pricklypear.

When the site is in excellent range condition, the annual production of air-dry herbage ranges from 2,000 pounds per acre in unfavorable years to 3,000 pounds in favorable years.

SHALLOW LIMY RANGE SITE

This site consists of shallow and very shallow, strongly sloping to steep, mainly somewhat excessively drained soils and land types on uplands. The surface layer and underlying material are loam or silt loam. Fertility is low, and the soils are droughty. The kind of vegetation that grows on this site is limited by the low or very low available water capacity and the high lime content of the soils.

At least 70 percent of the climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, side-oats grama, indiangrass, plains muhly, and prairie junegrass. Other perennial grasses, forbs, and shrubs make up the rest. Blue grama, hairy grama, buffalograss, sand dropseed, and various sedges are the principal increasers. This site rarely is in poor range condition because of livestock inaccessibility.

When the site is in excellent range condition, the annual production of air-dry herbage ranges from 1,500 pounds per acre in unfavorable years to 2,750 pounds in favorable years.

SHALLOW TO GRAVEL RANGE SITE

This site consists of gently sloping to steep, excessively drained, very shallow and shallow soils over mixed sand and gravel and land types on uplands. The surface layer is loamy sand, and the underlying material is medium sand. Below a depth of 4 to 20 inches is mixed sand and gravel. Permeability is rapid above the sand and gravel, and is very rapid in the sand and gravel. The kind of vegetation that grows on this site is mainly limited by the low available water capacity, the low natural fertility, and the coarse texture of the soils.

At least 60 percent of the climax plant cover is a mixture of such decreaser grasses as little bluestem, sand bluestem, switchgrass, side-oats grama, and prairie junegrass. Other perennial grasses and forbs make up the rest. Blue grama, hairy grama, western wheatgrass, sand dropseed, Scribner panicum, and various sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of blue grama, hairy grama, sand dropseed, prairie threeawn, curlycup gumweed, western ragweed, and common pricklypear.

When the site is in excellent range condition, the annual production of air-dry herbage ranges from 1,000 pounds per acre in unfavorable years to 2,250 pounds in favorable years.

THIN LOESS RANGE SITE

Only Rough broken land, loess, 20 to 60 percent slopes, is in this site. This land type has steep and very steep slopes and is on uplands. "Catsteps" are numerous. The soil material is silt loam and is calcareous at or near the surface. The kind of vegetation that grows on this site is mainly limited by the high content of lime, the steepness of slope, and lack of development in the soil material.

At least 65 percent of the climax plant cover is a mixture of such decreaser grasses as little bluestem, big bluestem, side-oats grama, switchgrass, and plains muhly. Other perennial grasses and forbs make up the rest. Blue grama, hairy grama, western wheatgrass, and various sedges are the principal increasers. The typical plant community when the site is in poor range condition consists of blue grama, hairy grama, sand dropseed, Kentucky bluegrass, broom snakeweed, and various annuals.

When the site is in excellent range condition, the annual production of air-dry herbage ranges from 1,500 pounds per acre in unfavorable years to 2,500 pounds in favorable years.

Windbreaks [4]

Native woodland in Franklin County is limited to rather narrow strips along the larger streams. The most extensive stands are on the Munjor, McCook, Wann, and Gibbon soils on bottom lands of the Republican River. These stands are made up mostly of east-

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

***Figure 21.*—Eastern redcedars in a windbreak designed to protect livestock. Feedlot is in an area of Holdrege silt loam.**

ern cottonwood and an understory of boxelder and willow. Stands also are mainly on Silty alluvial land along the Little Blue River, Center Creek, Thompson Creek, and tributaries of these streams. These stands mainly consist of American elm, boxelder, green ash, hackberry, willows, black walnut, bur oak, eastern cottonwood, and some woody shrubs. Native trees and shrubs contribute much to the natural beauty of the landscape of Franklin County. They benefit wildlife by producing food and cover.

Early settlers in Franklin County planted trees for protection, shade, and fenceposts. Throughout the years, landowners have continued to plant trees to protect their buildings and livestock. Windbreaks are especially needed in rural areas, because many trees are scarce and because the weather is severe. Windbreaks help to reduce home heating costs, control snow drifting, reduce soil erosion, provide shelter for livestock (fig. 21), improve habitat for wildlife, and beautify the home and countryside. Narrow windbreaks or screen plantings are also useful in urban areas where they slow the speed of the wind, settle the dust, and help to reduce the noise level.

Although trees are not easily established every year in Franklin County, generally they can be established and tree survival can be high if basic rules of tree culture are observed. Healthy seedlings of suited species, properly planted in a well prepared soil and carefully tended after planting, can survive and grow well.

Growth of trees

Table 3 shows the relative vigor and average height of trees and shrubs at 20 years of age for species suited to windbreaks in Franklin County. Detailed measurements were taken for most species listed in this table, but some tree heights and rating of vigor are estimated. The soils were grouped into 6 different windbreak suitability groups. The soils in each group are similar in characteristics that affect the growth of trees.

The ratings of vigor given in table 3 are based on observations of relative vigor and general condition of the trees. Those species that have a rating of *good* are best suited for windbreaks on soils of that group. A rating of good indicates that one or more of the following conditions generally apply: leaves (or needles) are normal in color and growth; only a small amount of deadwood (tops, branches, and twigs) occurs in the live crown; and damage resulting from disease, insects, and climate is limited. A rating of *fair* indicates that one or more of the following conditions generally apply: Leaves (or needles) are obviously normal in color and growth; a substantial amount of deadwood (tops, branches, and twigs) occurs in the live crown; damage resulting from disease, insects, and climate is moderate; and the current year's growth is obviously less than normal. A rating of *poor* indicates that one or more of the following conditions apply: Leaves (or needles) are very abnormal in color and growth; a very large amount of deadwood (tops, branches, and twigs) occurs within the live crown; and damage resulting from disease, insects, and climate is extensive.

The conifers are best suited for windbreaks in Franklin County, also, several broadleaf species are well suited. Eastern redcedar, ponderosa pine, Austrian pine, and Scotch pine are the most reliable species for windbreaks. All of these species rated high in survival and vigor in the studies that were made. These species hold their leaves in the winter, thus giving maximum protection when it is most needed.

TABLE 3.—*Relative vigor and average height, by windbreak groups, of specified trees and shrubs at 20 years of age*

[A dashed line indicates that height is not given for species that have a rating of poor. Ratings are not given for Group 10, because soils of this group are not generally suited to windbreak plantings]

Tree and shrub species	Group 1		Group 2		Group 3		Group 4		Group 5		Group 7	
	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*
Conifers:												
Austrian pine	Good	30	Good	24	Good	28	Good	26	Good	20	Good	24
Black Hills spruce	Good	22	Fair	16	Poor	---	Fair	16	Poor	---	Poor	---
Blue spruce	Good	24	Poor	---	Fair	20	Fair	18	Poor	---	Poor	---
Eastern redcedar	Good	22	Good	20	Good	22	Good	22	Good	16	Good	16
Ponderosa pine	Good	30	Poor	---	Good	28	Good	26	Good	20	Good	24
Scotch pine	Good	28	Good	24	Good	28	Good	26	Good	18	Fair	22
Broadleaf trees:												
American sycamore	Good	34	Good	30	Fair	26	Fair	28	Poor	---	Poor	---
Black walnut	Good	28	Poor	---	Fair	20	Fair	22	Poor	---	Poor	---
Bur oak	Good	24	Poor	---	Fair	20	Good	22	Good	16	Poor	---
Eastern cottonwood	Fair	60	Fair	55	Fair	52	Poor	---	Poor	---	Fair	40
Golden willow	Good	26	Good	28	Poor	---	Poor	---	Poor	---	Poor	---
Green ash	Good	28	Fair	24	Fair	26	Good	24	Fair	16	Poor	---
Hackberry	Good	26	Fair	20	Fair	22	Good	22	Fair	16	Poor	---
Honeylocust	Good	32	Fair	26	Good	28	Good	26	Fair	18	Fair	20
Midwest Manchurian crabapple	Good	16	Poor	---	Fair	12	Fair	14	Poor	---	Poor	---
Russian mulberry	Good	24	Good	22	Fair	20	Good	22	Poor	---	Poor	---
Silver maple	Good	34	Good	32	Poor	---	Fair	22	Poor	---	Poor	---
Shrubs:												
American plum	Good	8	Fair	6	Good	6	Fair	6	Poor	---	Fair	5
Amur honeysuckle	Good	10	Fair	8	Fair	6	Good	8	Poor	---	Poor	---
Amur maple	Good	12	Fair	10	Fair	10	Good	12	Poor	---	Poor	---
Autumn-olive	Good	14	Fair	10	Good	12	Good	12	Fair	8	Fair	8
Common chokecherry	Good	12	Good	10	Good	8	Good	10	Poor	---	Poor	---
Hansen rose	Good	6	Poor	---	Good	6	Good	6	Poor	---	Poor	---
Lilac	Good	8	Poor	---	Good	6	Good	8	Fair	6	Poor	---
Peking cotoneaster	Good	8	Poor	---	Fair	6	Good	6	Fair	6	Poor	---
Red-osier dogwood	Good	6	Good	8	Poor	---	Poor	---	Poor	---	Poor	---
Silver buffaloberry	Fair	8	Fair	8	Fair	6	Fair	6	Poor	---	Poor	---
Skunkbush sumac	Good	8	Poor	---	Good	8	Good	8	Good	6	Poor	---

Eastern redcedar can reach a height of 25 to 35 feet at maturity, depending on the kind of soil on which they are grown. Ponderosa pine, Austrian pine, and Scotch pine grow slightly faster and are somewhat taller at maturity than eastern redcedar.

Rate of growth in a windbreak varies widely in relation to the soil moisture condition and soil fertility. Exposure and arrangement of trees within the planting also have a marked effect on tree growth. Such trees as eastern cottonwood tend to grow fast and to die young. Siberian elm and Russian-olive grow rapidly and often are short lived. Furthermore, they are likely to invade areas in which they are not wanted. Boxelder and Russian mulberry commonly freeze back during severe winters. Green ash is susceptible to damage by borers.

Windbreak suitability groups

Soils of Franklin County are grouped according to characteristics that affect tree growth. To find the names of all the soils in any windbreak suitability group or to find the group to which any specified soil has been assigned, refer to the Guide to Mapping Units at the back of this survey. Soils in a group produce similar tree growth and survival under normal conditions of weather and care.

Soils in Nebraska are grouped in windbreak suitability groups according to a system that is used statewide. Not all groups are in Franklin County. Following are brief descriptions of the suitability groups in this county.

WINDBREAK SUITABILITY GROUP 1

This group consists of deep, nearly level, well drained or moderately well drained soils on bottom lands and stream terraces of the Republican River valley and its tributaries. A few areas are occasionally flooded. The surface layer is silt loam, and the underlying material is silt loam, clay loam, silty clay loam, or loam. Permeability is moderate or moderately slow. Available water capacity and natural fertility are high.

These soils generally provide good tree planting sites. Survival and growth of suited trees are good. Moisture competition from weeds and grasses is the principal limitation.

WINDBREAK SUITABILITY GROUP 2

This group consists of deep, nearly level, poorly drained and somewhat poorly drained soils in shallow depressions on uplands and on bottom lands. The soils on bottom lands have a water table at a depth of 2 to 6 feet. The surface layer is silt loam or fine sandy loam. In upland depressions the subsoil is clay or silty clay. The underlying material ranges from silt loam to sandy loam. Natural fertility is medium or high.

These soils generally provide good tree planting sites. Survival and growth of trees are good if the species selected are those that tolerate occasional excessive wetness. Establishment of tree seedlings can be difficult in wet years. The abundant and persistent herbaceous vegetation that inhabit these sites limits the establishment and maintenance of trees.

WINDBREAK SUITABILITY GROUP 3

This group consists of deep, nearly level to very gently sloping, well drained or excessively drained soils on bottom lands. The surface layer and subsoil are fine sandy loam, loamy sand, or loamy fine sand. The underlying material ranges from silt loam to fine sand. Permeability ranges from moderate to rapid. Available water capacity and natural fertility range from low to high.

These soils are good tree planting sites. Survival and growth of suited trees are fair. Lack of adequate moisture and the hazard of soil blowing are the principal limitations. Soil blowing can be prevented if strips of sod or other plant growth is maintained between the rows. Cultivation generally needs to be restricted to the tree rows.

WINDBREAK SUITABILITY GROUP 4

This group consists of deep, nearly level to strongly sloping, moderately well drained to somewhat excessively drained soils on uplands. The surface layer is silt loam and silty clay loam, and the subsoil is silt loam, silty clay loam, or silty clay. The underlying material is silt loam. Permeability is moderate, moderately slow, or slow. Available water capacity is high, and natural fertility is medium or high.

These soils generally provide good tree planting sites. Survival of suited trees is good, and growth is fair. Droughtiness and moisture competition from weeds and grasses are the principal limitations. Water erosion on the gently sloping to strongly sloping areas is a limitation. Lack of sufficient moisture because of the rapid runoff retards growth of trees on the steeper slopes.

WINDBREAK SUITABILITY GROUP 5

Only Coly-Uly silt loams, 3 to 9 percent slopes, eroded, is in this group. It consists of deep, gently sloping to strongly sloping, somewhat excessively drained or well drained soils on uplands. The surface layer, subsoil, and underlying material are silt loam. Permeability is moderate. Available water capacity is high, and natural fertility is medium or low. Soils in this group are typically calcareous at the surface or within a depth of about 15 inches.

These soils provide fair to poor tree planting sites. Survival and growth of suited trees are fair. Lack of adequate moisture and the calcareous condition of these soils are the principal limitations.

WINDBREAK SUITABILITY GROUP 7

This group consists of deep, very gently sloping to strongly sloping, well drained or excessively drained soils on hummocky uplands. The surface layer is fine sandy loam, loam, fine sand, or loamy sand. The underlying material is sandy loam or fine sand. Permeability is rapid or moderately rapid. Available water capacity and natural fertility are low.

These soils generally provide fair tree planting sites. Survival and growth of suited trees are fair. Young trees need to be planted in shallow furrows and not cultivated. The soil is so loose that cultivation increases the hazard of soil blowing, and young trees can be damaged by drifting sand during high winds. Only conifers are suited to plantings on these soils.

WINDBREAK SUITABILITY GROUP 10

This group consists of very shallow to deep, nearly level to very steep soils and land types on uplands, in depressions, and on bottom lands. These soils and land types have a wide range of soil characteristics. They are too shallow, gravelly, steep, stony, or wet for tree planting with machinery. They are too droughty, too wet, or too erodible for good survival and growth of tree and shrub plantings.

Soils of this group generally are not suited to windbreak plantings of any kind. Some areas can be used for recreation, for forestation, and for wildlife plantings of tolerant tree and shrub species if they are hand planted or special approved practices are used.

Wildlife and Recreation [5]

Wildlife populations are determined largely by the quality and quantity of vegetation that the land is capable of producing. Cover, food, and water, in proper combination, are the three essential elements that determine the abundance of wildlife.

Topography and soil characteristics, such as fertility, play a major role in determining wildlife populations. Fertile soils produce more and better quality wildlife, both game and nongame species, than do nonfertile soils. This section refers mainly to game species.

In many cases, the soils rated highest for wildlife potential do not have the highest wildlife populations. This is not the result of the inability of soils to produce wildlife habitat but rather the result of other factors, such as hunting pressure, clean tillage, and improved harvesting methods. The potential remains, however, and wildlife populations can be increased with little cost and effort. Wildlife has a place in both rural and urban settings and needs to be considered when planning for optimal use of these areas. Fish ponds that are filled by runoff from fertile fields generally produce more fish than average because of the increased food production. Zooplankton consists of microscopic animals, and phytoplankton consists of microscopic plants that are produced in fertile ponds. They provide food for larger aquatic animals such as frogs, which, in turn, are used as food by fish.

Areas of steep slopes and rough, irregular topography present hazards to livestock and are poorly suited to crop production. In these areas the natural undisturbed landscape can become escape cover for wildlife and provide a source of food. In many instances, where vegetation is lacking, flowering and fruiting trees and shrubs can be developed by plantings. For suitable species for plantings, see the section "Windbreaks."

Wetness, permeability, and available water capacity are important factors to consider when selecting pond sites for wildlife and recreation.

Table 4 shows the potential of the soil associations in Franklin County for producing elements of wildlife habitat and kinds of wildlife. The used ratings in table 4 are good, fair, poor, and very poor. *Good* means that habitats are easily improved, maintained, or created; that the soil has few or no limitations that affect management; and that satisfactory results can be expected. *Fair* means that habitats can be improved, maintained, or created, but the soil has moderate limitations that affect habitat management or development, and that moderately intensive management and fairly frequent attention may be required to ensure satisfactory results. *Poor* means that habitats can be improved, maintained, or created, but the soil has severe limitations; that habitat management may be difficult and expensive and require intensive effort; and that results are questionable. *Very poor* means that under the prevailing soil conditions, to improve, maintain, or create habitats is impractical and that unsatisfactory results are probable.

The elements of wildlife habitat rated in table 4 are briefly described in the following paragraphs.

Grain and seed crops consist of domestic grain or other seed-producing annuals planted to produce wildlife food. Examples are corn, sorghum, wheat, oats, barley, millet, soybeans, and sunflowers.

Domestic grasses and legumes consist of domestic perennial grasses and herbaceous legumes that are planted for wildlife cover and food. Examples are fescue, bluegrass, bromegrass, timothy, orchardgrass, clover, alfalfa, trefoil, and crownvetch.

Wild herbaceous plants are native or naturally established dryland herbaceous grasses and forbs (including weeds) that provide food and cover for wildlife. Examples are bluestem, indiangrass, goldenrod, beggarweed, partridgepea, pokeweed, wheatgrasses, fescues, and gramas.

Hardwood trees and shrubs include nonconiferous trees and associated woody understory plants that provide wildlife cover or that produce nuts, buds, catkins, twigs, bark, or foliage used as food by wildlife. Shrubby plants are shrubs that produce buds, twigs, bark, or foliage used as food by wildlife, or that provide cover and shade for some wildlife species. Examples are snowberry, honeysuckle, and Russian-olive.

Coniferous plants include cone-bearing trees, shrubs, or ground cover that furnish wildlife cover or supply food in the form of browse, seeds, or fruit-like cones. Commonly established through natural processes, they may be planted or transplanted. Examples are pine, spruce, fir, cedar, and juniper.

Wetland food and cover plants consist of annual and perennial wild herbaceous plants on moist to wet sites, exclusive of submerged or floating aquatics, that produce food or cover used extensively by wetland forms of wildlife. Examples are smartweed, wild millet, rushes, sedges, reeds, cordgrass, and cattail.

Shallow water areas are areas of surface water that have an average depth of less than 5 feet and that are useful to wildlife. They may be natural wet areas or those created by dams or levees or by water-control devices in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds.

The three kinds of wildlife rated in table 4 are briefly described in the following paragraphs.

Open-land wildlife are birds and mammals that inhabit croplands, pastures, meadows, lawns and areas overgrown with grasses, herbs, shrubs, and vines. Examples are quail, pheasant, meadowlark, killdeer, cottontail rabbit, badger, and red fox.

Woodland wildlife are birds and mammals that in-

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

TABLE 4.—*Potential of soil associations for producing elements of wildlife habitat and kinds of wildlife*

Soil associations	Wildlife habitat elements—							Kinds of wildlife—		
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees and shrubs	Coniferous plants	Wetland food and cover plants	Shallow water areas	Open-land	Woodland	Wetland
Holdrege	Good	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Nuckolls-Holdrege-Uly:										
Nuckolls part:										
3 to 9 percent slopes	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
9 to 30 percent slopes	Poor	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Holdrege part	Good	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Uly part:										
3 to 11 percent slopes	Fair	Good	Good	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
11 to 30 percent slopes	Poor	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Valentine-Hersh-Nuckolls:										
Valentine part:										
0 to 6 percent slopes	Fair	Good	Fair	Poor	Poor	Very poor	Very poor	Fair	Poor	Very poor.
6 percent slopes	Poor	Fair	Fair	Poor	Poor	Very poor	Very poor	Fair	Poor	Very poor.
Hersh part:										
1 to 11 percent slopes	Fair	Good	Good	Fair	Fair	Very poor	Very poor	Fair	Poor	Very poor.
11 to 30 percent slopes	Poor	Fair	Good	Poor	Fair	Very poor	Very poor	Fair	Poor	Very poor.
Nuckolls part:										
3 to 11 percent slopes	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
11 to 30 percent slopes	Poor	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Munjor-Inavale-McCook:										
Munjor part	Good	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
Inavale part:										
0 to 2 percent slopes	Fair	Good	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
2 to 6 percent slopes	Poor	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
McCook part	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
Nuckolls-Holdrege-Campus:										
Nuckolls part:										
3 to 11 percent slopes	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.
11 to 30 percent slopes	Poor	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor.
Holdrege part	Good	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor.
Campus part	Poor	Fair	Good	Poor	Poor	Very poor	Very poor	Good	Poor	Very poor.
Hord	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor.

habit wooded areas consisting of hardwood or coniferous trees and shrubs, or a mixture of both. Examples are wild turkey, prairie grouse, thrushes, vireos, woodpecker, squirrel, raccoon, white-tailed deer, and mule deer.

Wetland wildlife are birds and mammals that inhabit swampy, marshy, or open-water areas. Examples are ducks, geese, herons, shore birds, rails, kingfishers, muskrat, and beaver.

Kinds of wildlife by soil association

Holdrege association.—The Holdrege association is nearly level and very gently sloping. It has some of the best cultivated soils on the uplands of Franklin County. Nearly all the acreage of this association is cultivated. Irrigation is important, because it increases production of crops that are an important source of food for wildlife. A few of the wet, undrained depressional areas are in permanent grassland. Shore birds and waterfowl use these areas as wetland habitat.

Trees, which are scattered along some drainageways and in corners of fields, and field windbreaks provide woody cover for wildlife.

In the Holdrege association open-land wildlife prevails. Quail are most abundant, and pheasants are next. Other common species are cottontail rabbit and songbirds. White-tailed deer frequent the area when crops are standing and move back to the brushy draws after the crops are harvested.

Nuckolls-Holdrege-Uly association.—In the western part of the Nuckolls-Holdrege-Uly association, the steeper slopes are in native grasses, mainly bluestems, indiangrass, and side-oats grama. Areas that are not so sloping are in crops, mainly milo, wheat, and alfalfa.

The chief wildlife species in the Nuckolls-Holdrege-Uly association are quail, some pheasants, white-tailed deer, squirrel, raccoon, and such predators as fox and coyote. More quail and pheasants are in the eastern part of this association than in the western part because a larger acreage of the land is cultivated, because more herbaceous cover, such as dogwoods and plum, is in the drainageways, and because few of the nearly level areas in the eastern part are irrigated, which insures growth of a crop and also provides water for wildlife.

Valentine-Hersh-Nuckolls association.—Most of this association is in native grasses. Cottonwood, Center, Thompson, and Sassacus Creeks drain this association (fig. 22). These creeks are dry most of the year except in places where they drain into the Republican River. Eastern cottonwood, willow, and redcedar are common species. The wildlife in this association are mainly squirrels, raccoon, white-tailed deer, rodents, and songbirds.

Munjor-Inavale-McCook association.—All of the habitat elements required for a wide variety of wildlife are present in this association. Woodlands consisting of oak, ash, willow, and eastern cottonwood are along the Republican River. This provides habitat for woodland species such as deer, squirrel, and raccoon. The crops and alfalfa in the areas on bottom lands provide food for wildlife, and the channels of the Republican River provide water. A few small, marshy areas in the association provide habitat for such wetland wildlife as muskrat, mink, weasel, waterfowl, and shore birds.

***Figure 22.*—Wildlife cover along Thompson Creek.**

Nuckolls-Holdrege-Campus association.—This association is in areas south of the Republican River. Rock outcrop is common along the steeper slopes. The potential for wildlife habitat is similar to that of the Nuckolls-Holdrege-Uly association.

Hord association.—Most of this association is nearly level. It is on stream terraces of the Republican River valley. This area provides plenty of food and cover for most kinds of wildlife in Franklin County. Cover is adequate for the smaller species but is not plentiful for larger animals as it is in the steeper upland areas. Many small ponds in this association are near the base of adjacent uplands. Water from springs seeps into the ponds and is adequate to maintain the water level in the ponds.

Resources for recreation

Public recreational facilities in the county are in the Limestone Bluffs area, which is 480 acres in size, and the Ash Grove area, which is 80 acres in size. In addition, the Harlan County Reservoir is in adjacent Harlan County. This reservoir provides excellent water based recreational opportunities for residents of Franklin County.

The Nebraska Game and Parks Commission manages 480 acres of public hunting land 5 miles south and 4 miles east of Franklin.

The U.S. Fish and Wildlife Service manages three areas, which provide hunting of small game and waterfowl. The largest of these areas is 6 miles north of Franklin and contains 880 acres; an area 11 miles north and 5 miles west of Franklin contains 80 acres; and an area 14 miles north and 8 miles west of Franklin contains 520 acres.

The City of Franklin provides a 9-hole golf course and a 1-mile race track for recreation.

Stream fishing is limited in the county. This is due to the low natural water flows, the removal of water from streams for irrigation purposes, and the excessive number of rough fish. Farm ponds offer fishing of bass, bluegill, and catfish.

Of historical interest in Franklin County are the sites of prehistoric aboriginal villages: The *Copley site* on the north side of Reams Creek, 2 miles east and 3 miles south of Franklin; the *Ted Hill site* on the south side of Reams Creek, 3 miles south and 2 miles east of Franklin; the *Lost Creek site,* 2 miles east and 5 miles south of Bloomington; the *Milo Hill site,* 4½ miles north and 3 miles west of Bloomington; and the *Rebecca Creek site,* 3 miles south and 2 miles east of Naponee.

Technical assistance in planning wildlife developments and determining which species of vegetation to use can be obtained at the local office of the Soil Conservation Service in Franklin. Additional information and assistance can be obtained from the Nebraska Game and Parks Commission, the U.S. Fish and Wildlife Service, and the Cooperative Extension Service. The Soil Conservation Service also provides technical assistance in planning and applying conservation practices developing outdoor recreation facilities.

Engineering Uses 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.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage condition, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and 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 be helpful to those who—

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

[6] WAYNE W. LIESEMEYER, engineer, Soil Conservation Service, assisted in the preparation of this section.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, several estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 5 and 6, and it also can be used to make other useful maps.

This information, however, is not intended for use in design and 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 more than 6 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 a different meaning in soil science than in engineering. The Glossary defines many of these terms as they are commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*2*), used by SCS engineers, Department of Defense, and others, and the AASHTO system (*1*), adopted by the American Association of State Highway and Transportation Officials.

The Unified system is used to classify soils according to engineering uses for building material or for the support of structures other than highways. Soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes. There are eight classes of coarse-grained soils that are subdivided on the basis of gravel and sand content. These are identified as GW, GP, GM, GC, SW, SP, SM, and SC. There are six classes of fine-grained soils that are subdivided on the basis of plasticity index. Nonplastic classes are ML, MH, OL, and OH; plastic classes are CL and CH. There is one class of highly organic soils, Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example CL-ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups, ranging from A–1 through A–7, on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify and further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested

TABLE 5.—*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. fully the instructions for referring to other series that appear in the first

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Ft	*Ft*	*In*			
Broken alluvial land: Br. Most properties too variable to be estimated.	>10					
Butler: Bu	>10	>10	0–14	Silt loam	CL-ML or CL	A–4 or A–6
			14–31	Clay and silty clay.	CH	A–7
			31–41	Silty clay loam.	CL or CH	A–6 or A–7
			41–60	Silt loam	CL	A–6 or A–7
Campus: CaF	1.5–3.2	>10	0–8	Loam	ML or CL-ML	A–4
			8–16	Loam	ML or CL-ML	A–4
			16–25	Loam	ML	A–4 or A–6
			25	Sandstone.		
*Canyon: CnF. For Campus part, see Campus series.	1–1.6	>10	0–14	Loam	CL-ML, CL, SM-SC or SC	A–4 or A–6
			14	Sandstone.		
*Coly: CoD2, CoF. For Uly part, see Uly series.	>10	>10	0–5	Silt loam	CL	A–6
			5–60	Silt loam	ML or CL-ML	A–4
Detroit: De	>10	>10	0–15	Silt loam	ML	A–4
			15–18	Silty clay loam.	CL or CH	A–6 or A–7
			18–35	Silty clay	CH	A–7
			35–60	Silt loam	CL	A–6 or A–7
Fillmore: Fm	>10	>10	0–16	Silt loam	ML	A–4
			16–34	Silty clay	CH	A–7
			34–46	Silty clay loam.	CL or CH	A–7 or A–6
			46–60	Silt loam	CL	A–4 or A–6
Gibbon: Gb	>10	2–4	0–7	Silt loam	CL	A–6 or A–7
			7–15	Silty clay loam.	CL or CH	A–7 or A–6
			15–24	Silt loam	CL	A–6 or A–7
			24–60	Very fine sandy loam.	ML	A–4
Gravelly land complex: GcF. Most properties too variable to be estimated.	>10	>10				
Hall: Ha, Hb	>10	>10	0–18	Silt loam	ML or CL	A–4 or A–6
			18–32	Silty clay loam.	CL	A–6 or A–7
			32–60	Silt loam	CL	A–6
Hastings: Hc	>10	>10	0–9	Silt loam	CL	A–6
			9–37	Silty clay loam.	CL or CH	A–7
			37–60	Silt loam	CL	A–6 or A–7
*Hersh: HdC, HdD. For Valentine part, see Valentine series.	>10	>10	0–8	Fine sandy loam.	SM	A–4
			8–40	Sandy loam	SM	A–2 or A–4
			40–60	Loamy sand	SM	A–2 or A–4
Hobbs: Hf	>10	>10	0–60	Silt loam	ML or CL	A–4 or A–6

significant in engineering

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow care- column of this table. Symbol > means more than; symbol < means less than]

Percentage less than 3 inches passing sieve— No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
						In per hr	*In per in of soil*	*pH*	
		100	95–100	20–40	5–15	0.6–2.0	0.22–0.24	6.1–7.3	Moderate.
		100	95–100	50–70	25–45	0.06–0.2	0.10–0.14	6.6–7.8	High.
		100	95–100	35–60	15–35	0.2–0.6	0.18–0.20	7.9–8.4	High.
		100	90–100	30–45	11–25	0.6–2.0	0.20–0.22	7.9–8.4	Moderate.
	100	85–100	51–85	20–40	5–10	0.6–2.0	0.20–0.22	7.4–8.4	Low to moderate.
	100	85–100	51–75	20–40	5–10	0.6–2.0	0.17–0.19	7.4–8.4	Low to moderate.
100	95–100	90–100	60–90	20–40	5–15	0.6–2.0	0.20–0.22	7.4–8.4	Low to moderate.
95–100	90–100	80–100	45–70	20–40	5–15	0.6–2.0	0.20–0.22	7.4–8.4	Low to moderate.
		100	95–100	30–45	11–25	0.6–2.0	0.22–0.24	7.4–7.8	Moderate.
		100	95–100	25–40	4–11	0.6–2.0	0.20–0.22	6.1–7.3	Moderate.
		100	90–100	30–40	3–10	0.6–2.0	0.22–0.24	7.4–8.4	Moderate.
		100	95–100	35–60	15–30	0.2–0.6	0.18–0.20	6.1–7.3	Moderate.
		100	95–100	51–70	25–30	0.06–0.2	0.12–0.14	6.6–7.8	High.
		100	90–100	35–45	15–25	0.6–2.0	0.20–0.22	7.4–8.4	Moderate.
		100	95–100	20–35	2–10	0.6–2.0	0.22–0.24	6.1–6.5	Moderate.
		100	97–100	50–75	30–45	<0.06	0.12–0.13	6.6–7.8	High.
		100	95–100	40–60	20–40	0.2–0.6	0.18–0.20	7.4–7.8	High.
		100	95–100	25–40	10–20	0.6–2.0	0.20–0.22	7.9–8.4	Moderate.
	100	95–100	90–100	20–45	15–25	0.6–2.0	0.22–0.24	7.4–8.4	Moderate.
		100	95–100	25–45	18–25	0.2–0.6	0.18–0.20	7.4–8.4	Moderate to high.
	100	95–100	80–95	20–45	15–25	0.6–2.0	0.20–0.22	7.9–8.4	Moderate.
	100	85–95	50–70	[1] NP	NP	0.6–2.0	0.17–0.19	8.5–9.0	Low.
		100	95–100	30–40	6–18	0.6–2.0	0.22–0.24	6.1–7.3	Moderate.
		100	97–100	35–50	15–30	0.2–0.6	0.18–0.20	6.6–7.3	Moderate to high.
		100	95–100	30–40	12–20	0.6–2.0	0.20–0.22	6.6–8.4	Moderate.
		100	95–100	28–40	11–20	0.6–2.0	0.22–0.24	6.1–7.3	Moderate.
		100	97–100	42–60	22–40	0.2–0.6	0.18–0.20	6.1–7.3	High.
		100	95–100	30–48	11–25	0.6–2.0	0.20–0.22	7.4–8.4	Moderate.
	100	95–100	36–50	15–40	NP	2.0–6.0	0.16–0.18	6.1–7.3	Low.
	100	60–70	15–50	NP	NP	2.0–6.0	0.12–0.14	6.6–7.3	Low.
	100	60–70	15–50	NP	NP	6.0–20	0.08–0.10	6.6–7.3	Low.
		100	95–100	25–40	4–20	0.6–2.0	0.20–0.24	6.6–7.8	Low to moderate.

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Ft	*Ft*	*In*			
*Holdredge: Hh, HhB, HhC, HhD, HnD2. For Uly part of HnD2, see Uly series.	>10	>10	0–13	Silt loam	CL	A–6
			13–26	Silty clay loam.	CL or CH	A–7
			26–60	Silt loam	CL	A–6
Hord: Hr, HrB	>10	>10	0–16	Silt loam	CL-ML or CL	A–4 or A–6
			16–29	Silt loam	CL	A–6 or A–7
			29–60	Silt loam	CL	A–6
Inavale: Ig, In	>10	5–10	0–8	Loamy sand	SM	A–2
			8–24	Loamy sand	SM	A–2
			24–60	Sand	SP-SM, SM, or SP	A–2 or A–3
Kenesaw: Kn, KnB, KnC	>10	>10	0–8	Silt loam	CL	A–6
			8–20	Silt loam	CL	A–6
			20–60	Silt loam	CL or CL-ML	A–6
Kipson: KsF	1–1.6	>10	0–7	Silt loam	CL	A–4 or A–6
			7–13	Silt loam	CL	A–6
			13–19	Silt loam	CL	A–6
			19	Chalky shaly and soft limestone.		
Marsh: Ma. Most properties too variable to be estimated.						
McCook:						
Mb	>10	5–8	0–11	Fine sandy loam.	SM or ML	A–4
			11–21	Silt loam	ML	A–4
			21–49	Very fine sandy loam.	ML	A–4
			49–60	Sandy loam	SM or ML	A–4
Mc	>10	5–8	0–11	Silt loam	CL-ML or CL	A–4
			11–21	Silt loam	ML	A–4
			21–49	Very fine sandy loam.	ML	A–4
			49–60	Sandy loam	SM or ML	A–4
Meadin. Mapped only with Nuckolls soils.	>10	>10	0–8	Loam	ML	A–4
			8–14	Gravelly sandy loam.	SM	A–2
			14–60	Coarse sand and gravel.	SP, SW, or SW-SM	A–3 or A–1
Munjor: Mn, Mu	>10	6–8	0–9	Fine sandy loam.	CL-ML, ML, or SM	A–2 or A–4
			9–46	Sandy loam	SM or ML	A–4
			46–60	Coarse and medium sand.	SM or SP-SM	A–2 or A–3
*Nuckolls: NhF, NmC, NmD, NoD2, NpD. For Hobbs part of NhF; for Holdredge part of NkC, NmD, and NoD2; and for Meadin part of NpD, see their respective series.	>10	>10	0–10	Silt loam	CL	A–6 or A–4
			10–29	Silt loam	CL	A–6
			29–60	Silt loam	CL	A–6 or A–4
Riverwash: Ra. Most properties too variable to be estimated.	>10	>10				

significant in engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)			*In per hr*	*In per in of soil*	*pH*	
----------	----------	100	95–100	25–40	11–14	0.6–2.0	0.22–0.24	5.6–6.5	Moderate.
----------	----------	100	95–100	40–55	20–35	0.6–2.0	0.18–0.20	6.1–7.8	Moderate to high.
----------	----------	100	95–100	30–40	11–20	0.6–2.0	0.20–0.22	7.4–8.4	Moderate.
----------	----------	100	95–100	25–35	5–15	0.6–2.0	0.22–0.24	6.1–7.3	Low.
----------	----------	100	95–100	30–45	11–20	0.6–2.0	0.20–0.22	6.1–7.3	Moderate.
----------	----------	100	95–100	25–40	11–17	0.6–2.0	0.20–0.22	7.4–8.4	Low.
100	100	85–95	15–35	NP	NP	2.0–20	0.10–0.18	6.6–8.4	Low.
100	90–100	65–80	15–30	NP	NP	6.0–20	0.09–0.11	6.6–8.4	Low.
100	90–100	70–90	5–20	NP	NP	6.0–20	0.05–0.07	6.6–8.4	Low.
----------	100	95–100	85–100	20–40	11–15	0.6–2.0	0.22–0.24	6.6–7.3	Low.
----------	100	90–100	85–100	20–40	11–18	0.6–2.0	0.17–0.19	6.6–7.3	Low.
----------	100	95–100	90–100	20–40	5–15	0.6–2.0	0.20–0.22	7.4–8.4	Low.
----------	----------	90–95	70–95	25–40	8–20	0.6–2.0	0.22–0.24	7.9–8.4	Low.
85–100	85–100	75–95	60–80	30–40	11–20	0.6–2.0	0.20–0.22	7.9–9.0	Moderate.
80–95	80–95	70–90	60–80	30–40	11–25	0.6–2.0	0.20–0.22	7.9–9.0	Moderate.
----------	100	70–85	36–55	NP	NP–5	2.0–6.0	0.16–0.18	7.4–7.8	Low.
----------	100	95–100	90–98	18–35	2–10	0.6–2.0	0.20–0.22	7.4–8.4	Low.
----------	100	95–100	90–98	18–35	NP–10	0.6–2.0	0.17–0.19	7.4–8.4	Low.
100	98–100	70–90	36–70	NP	NP	2.0–6.0	0.11–0.13	7.9–8.4	Low.
----------	100	95–100	65–98	18–35	7–10	0.6–2.0	0.22–0.24	7.4–7.8	Low.
----------	100	95–100	90–98	18–35	2–10	0.6–2.0	0.20–0.22	7.4–8.4	Low.
----------	100	95–100	90–98	18–35	NP–10	0.6–2.0	0.17–0.19	7.4–8.4	Low.
100	98–100	70–90	36–70	NP	NP	2.0–6.0	0.11–0.13	7.9–8.4	Low.
95–100	93–100	80–95	51–65	18–35	<10	0.6–2.0	0.20–0.22	6.1–6.5	Low.
50–90	35–87	21–60	10–35	NP	<3	2.0–6.0	0.12–0.14	6.1–6.5	Low.
40–90	18–60	9–35	1–8	NP	NP	>20	0.02–0.04	6.1–6.5	Low.
----------	100	70–98	15–65	NP–35	NP–10	2.0–20	0.14–0.18	7.4–8.4	Low.
100	95–100	90–100	35–65	10–30	3–6	2.0–6.0	0.13–0.14	7.4–8.4	Low.
98–100	90–100	55–70	5–30	NP	NP	0.6–20	0.06–0.10	7.4–8.4	Low.
----------	----------	95–100	90–95	24–40	8–15	0.6–2.0	0.22–0.24	6.6–7.8	Moderate.
----------	----------	95–100	85–90	28–40	11–20	0.6–2.0	0.20–0.22	7.4–7.8	Moderate.
----------	----------	95–100	80–90	25–40	8–20	0.6–2.0	0.20–0.22	7.4–7.8	Moderate.
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TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to—		Depth from surface	USDA texture	Classification	
	Bedrock	Seasonal high water table			Unified	AASHTO
	Ft	*Ft*	*In*			
Rough broken land: RbG. Most properties too variable to be estimated.	>10	>10				
Rough stony land: RcF. Most properties too variable to be estimated.	0–1	>10				
Roxbury: Rx	>10	6–10	0–46	Silt loam	ML, CL	A–4 or A–6
			46–60	Silty clay loam.	CL	A–6
Sandy alluvial land: Sa. Most properties too variable to be estimated.						
Scott: Sc	>10	>10	0–8	Silt loam	ML, CL, or CL-ML	A–4 or A–6
			8–20	Silty clay	CH	A–7
			20–34	Clay	CH	A–7
			34–46	Silty clay loam.	CL or CH	A–7 or A–6
			46–60	Silt loam	CL	A–4 or A–6
Uly: UaC, UaD	>10	>10	0–9	Silt loam	ML or CL	A–4 or A–6
			9–26	Silt loam	ML or CL	A–4 or A–6
			26–60	Silt loam	ML or CL	A–4 or A–6
*Valentine: VaF, VhD. For Hersh part of VhD, see Hersh series.	>10	>10	0–5	Loamy sand	SM, SP, or SP-SM	A–2 or A–3
			5–60	Fine sand	SM, SP, or SP-SM	A–2 or A–3
Wann:						
Wa	>10	2–4	0–11	Fine sandy loam.	SM	A–2 or A–4
			11–42	Sandy loam	SM	A–2
			42–60	Loamy sand and gravel.	SM, SP, or SP-SM	A–2 or A–3
Wb	>10	2–4	0–11	Silt loam	CL-ML	A–4
			11–42	Sandy loam	SM	A–2
			42–60	Loamy sand and gravel.	SM, SP, or SP-SM	A–2 or A–3

[1] NP=Nonplastic.

soils, with group index numbers in parentheses, is shown in table 7; the estimated classification, without group index numbers, is given in table 5 for all soils mapped in the survey area.

Soil properties significant to engineering

Several estimates of soil properties significant in engineering are given in table 5. These estimates are made for representative soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 5.

Depth to bedrock is the distance from the surface of the soil to a rock layer within the depth of observation.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Texture is described in table 5 in the standard terms used by the U.S. Department of Agriculture. These terms are based on the percentages of sand, silt, and clay in the soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that *significant in engineering*—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						
						In per hr	*In per in of soil*	*pH*	
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
----------	100	95–100	85–100	30–40	8–25	0.6–2.0	0.17–0.24	7.4–8.4	Moderate.
----------	100	95–100	85–95	30–45	8–25	0.6–2.0	0.17–0.22	----------	
----------	----------	100	95–100	20–35	2–12	0.6–2.0	0.22–0.24	6.1–6.5	Moderate.
----------	----------	100	95–100	50–75	30–45	<0.06	0.15–0.17	6.6–7.8	High.
----------	----------	100	95–100	50–75	30–45	<0.06	0.10–0.12	6.6–7.8	High.
----------	----------	100	95–100	35–60	20–40	0.2–0.6	0.18–0.20	6.6–7.8	High.
----------	----------	100	95–100	25–40	8–20	0.6–2.0	0.20–0.22	7.4–7.8	Moderate.
----------	----------	100	95–100	25–35	7–15	0.6–2.0	0.22–0.24	6.1–7.3	Moderate.
----------	----------	100	95–100	30–40	12–18	0.6–2.0	0.20–0.22	6.1–7.8	Moderate.
----------	----------	100	95–100	25–35	9–15	0.6–2.0	0.20–0.22	7.4–8.4	Moderate.
----------	100	90–100	2–25	NP	NP	6.0–20	0.10–0.12	6.1–7.3	Low.
----------	100	95–100	2–20	NP	NP	6.0–20	0.06–0.08	6.1–7.3	Low.
95–100	90–100	70–85	30–45	NP	NP	2.0–6.0	0.16–0.18	7.4–8.4	Low.
95–100	90–100	70–80	30–35	NP	NP	2.0–6.0	0.12–0.14	7.4–8.4	Low.
95–100	90–100	65–85	3–15	NP	NP	6.0–20	0.05–0.07	7.4–8.4	Low.
98–100	95–100	85–95	55–75	15–30	5–10	0.6–2.0	0.22–0.24	7.4–8.4	Low.
98–100	95–100	70–80	30–35	NP	NP	2.0–6.0	0.12–0.14	7.4–8.4	Low.
95–100	90–100	65–85	3–15	NP	NP	6.0–20	0.05–0.07	7.4–8.4	Low.

contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil materials. As the water content of a clayey soil, from which the particles coarser than 0.42 millimeter have been removed, is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic state; and the liquid limit, from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of water content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 5, but in table 7 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is estimated on basis of those soil characteristics observed in the field, particularly structure, porosity, and texture. Lateral seepage or such transient soil features as plowpans and surface crusts are not considered.

Available water capacity is an estimate of the capac-

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The the instructions for referring to other series

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	
					Trench type	Area type
Broken alluvial land: Br. Too variable to be rated. Severe for most uses because of flooding.						
Butler: Bu	Severe: slow permeability between depths of 14 and 31 inches.	Severe: flooding.	Severe: somewhat poorly drained; clayey subsoil; difficult to work.	Severe: high shrink-swell potential; difficult to work; flooding.	Severe: clayey subsoil; high shrink-swell potential; flooding.	Moderate: flooding.
Campus: CaF	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe with basements and moderate without basements: bedrock at depth of 20 to 40 inches; slope.	Moderate. rippable bedrock at a depth of 20 to 40 inches.	Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.
*Canyon: CnF For Campus part, see Campus series.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
*Coly: CoD2, CoF For Uly part, see Uly series.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.	Moderate where slopes are 3 to 7 percent: moderate permeability. Severe where slopes are more than 7 percent.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.	Moderate where slopes are 3 to 15 percent. Severe where slopes are more than 15 percent.	Slight where slopes are 3 to 15 percent. Moderate where slopes are 15 to 25 percent. Severe where slopes are more than 25 percent.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.

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

Degree and kind of limitation for—Con't.		Suitability as source of—			Soil features affecting—				
Sanitary landfill—Con't. Cover material	Local roads and streets	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Good in surface layer; poor in subsoil.	Severe: plastic subsoil; high shrink-swell potential.	Poor: clayey; plastic subsoil; high shrink-swell potential.	Unsuited [1]	Good to depth of 14 inches. Poor below depth of 14 inches.	Low seepage; suited to excavated pond.	High compressibility in subsoil; low permeability where compacted; fair to poor compaction characteristics.	Occasional ponding; slow internal drainage; outlets not available in places.	High available water capacity; low intake rate; needs adequate drainage.	Generally not needed: nearly level.
Poor: limited material.	Moderate where slopes are 9 to 15 percent: bedrock at depth of 20 to 40 inches. Severe where slopes are more than 15 percent.	Poor: limited material.	Unsuited [1]	Poor: limited material; areas difficult to reclaim.	Bedrock at depth of 20 to 40 inches; moderate seepage.	Limited material available; erodes easily.	Practice generally not suited; well drained.	Practice generally not suited.	Practice generally not suited.
Poor: limited material.	Severe: bedrock at depth of 10 to 20 inches.	Poor: limited material; bedrock at a shallow depth.	Unsuited [1]	Poor: limited material; bedrock at a shallow depth.	Bedrock at depth of 10 to 20 inches; moderate to high seepage.	Bedrock at depth of 10 to 20 inches; susceptible to piping.	Generally not needed; well drained.	Generally not suited.	Generally not suited.
Good to poor: slope.	Moderate where slopes are 8 to 15 percent: moderate shrink-swell potential. Severe where slopes are more than 15 percent: susceptible to frost action.	Fair where slopes are less than 25 percent: plasticity index less than 15 percent; moderate shrink-swell potential; susceptible to frost action. Poor where slopes are more than 25 percent.	Unsuited [1]	Fair where slopes are 8 to 15 percent. Poor where slopes are more than 15 percent.	Moderate seepage; moderate permeability; slopes of 3 to 30 percent.	Susceptible to piping; low permeability where compacted; medium to low shear strength.	Generally not needed; somewhat excessively drained.	Erodes easily; complex slopes; CoF not suited because of excessive slope.	Erodes easily; steep in some areas.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	
					Trench type	Area type
Detroit: De	Severe: slow permeability.	Slight	Severe: silty clay subsoil; difficult to work.	Severe: high shrink-swell potential; plastic subsoil.	Severe: clayey subsoil; difficult to work.	Slight
Fillmore: Fm	Severe: very slow permeability; occasional flooding.	Severe: hazard of ponding.	Severe: poorly drained; occasional flooding; clayey subsoil.	Severe: poorly drained; high shrink-swell potential; plastic subsoil; occasional flooding.	Severe: poorly drained; occasional flooding; clayey subsoil; difficult to work.	Severe: poorly drained; occasional flooding; clayey subsoil; difficult to work.
Gibbon: Gb	Severe: moderately slow permeability; seasonal high water table at depth of 2 to 4 feet.	Severe: seasonal high water table at depth of 2 to 4 feet.	Severe: somewhat poorly drained; seasonal high water table at depth of 2 to 4 feet.	Severe: high potential frost action; seasonal high water table at depth of 2 to 4 feet; rare flooding.	Severe: water table at depth of 2 to 4 feet; rare flooding.	Severe: water table at depth of 2 to 4 feet; rare flooding.
Gravelly land: GcF	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.[a]	Very severe: very rapid permeability.	Severe: mixed sand and gravel; poor sidewall stability.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.	Severe: sand and gravel.	Severe: very rapid permeability.

interpretations—Continued

Degree and kind of limitation for—Con't.		Suitability as source of—			Soil features affecting—				
Sanitary landfill—Con't. Cover material	Local roads and streets	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Good in surface layer; poor in subsoil.	Severe: high shrink-swell potential.	Poor: clayey, plastic subsoil; high shrink-swell potential.	Unsuited [1]	Fair: too clayey.	Slow permeability; nearly level.	High shrink-swell potential; fair compaction characteristics.	Moderately well drained; slow permeability; clayey subsoil; nearly level; good outlets lacking in places.	Slow intake rate; slow permeability; high available water capacity; nearly level.	Generally not needed: nearly level.
Poor: slope.	Severe: occasional flooding; high shrink-swell potential.	Poor: plastic subsoil; high shrink-swell potential; hazard of flooding; susceptible to frost action.	Unsuited [1]	Poor: wetness; subsoil is high in clay; poorly drained.	Low seepage; depressional; good for excavated pond.	Medium to high compressibility; fair to poor workability; good to poor stability.	Poorly drained; subject to occasional ponding; poor internal drainage; adequate outlets not available in places.	High available water capacity; very slow permeability in subsoil; needs adequate surface drainage.	Generally not needed: nearly level.
Good	Severe: high shrink-swell potential; susceptible to frost action; rare flooding.	Poor: plastic material; high susceptibility to frost action.	Unsuited: below a depth of 5 feet needs onsite inspection.	Good to fair: too clayey.	High seepage below depth of 3 feet; seasonal high water table at depth of 2 to 4 feet; rare flooding.	Fair to good compaction characteristics; medium to low shear strength; low to medium susceptibility to piping.	Somewhat poorly drained; seasonal high water table at depth of 2 to 4 feet; outlets not available in places; moderately slow permeability; nearly level; rare flooding.	High available water capacity; moderately slow permeability; seasonal high water table at depth of 2 to 4 feet.	Generally not needed: nearly level.
Poor: texture too coarse.[2]	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.	Good where slopes are 3 to 15 percent. Fair where slopes are more than 15 percent.	Good to fair: needs onsite inspection for gradation; mainly fine and medium gravel.	Poor: texture too coarse.	High seepage; porous; very rapid permeability.	High seepage; low compressibility; good compaction characteristics.	Generally not needed.	Generally not suited.	Generally not suited.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	
					Trench type	Area type
Hall: Ha, Hb	Moderate: moderately slow permeability.	Slight	Slight	Moderate: moderate to high shrink-swell potential; potential frost action.	Moderate: moderately slow permeability.	Slight
Hastings: Hc	Severe: moderately slow permeability.	Slight	Moderate: moderately well drained.	Severe: high shrink-swell potential.	Moderate: moderately well drained; difficult to work.	Slight
*Hersh: HdC, HdD For Valentine part, see Valentine series.	Slight where slopes are 1 to 8 percent. Moderate where slopes are 8 to 11 percent.[2]	Severe: moderately rapid permeability; requires sealing or lining for proper functioning.	Slight where slopes are 1 to 8 percent. Moderate where slopes are 8 to 11 percent.	Slight where slopes are 1 to 8 percent. Moderate where slopes are 8 to 11 percent.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.
Hobbs: Hf	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.
*Holdredge: Hh, HhB, HhC, HhD, HnD2. For Uly part of HnD2, see Uly series.	Slight where slopes are 0 to 8 percent. Moderate where slopes are more than 9 percent.	Moderate where slopes are 2 to 7 percent: moderate permeability. Severe where slopes are more than 7 percent.	Slight	Moderate: moderate shrink-swell potential; susceptible to frost action.	Moderate: silty clay loam subsoil.	Slight

interpretations—Continued

Degree and kind of limitation for—Con't.		Suitability as source of—			Soil features affecting—				
Sanitary landfill—Con't. Cover material	Local roads and streets	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Fair for trench type; silty clay loam subsoil. Good for area type.	Severe: plasticity index more than 15 percent; high shrink-swell potential.	Poor: plastic subsoil; moderate to high shrink-swell potential.	Unsuited [1]	Fair: moderate to high shrink-swell potential.	Low seepage; nearly level.	Slopes erodible; medium to low shear strength; susceptible to piping.	Well drained; moderately slow permeability; nearly level.	High available water capacity; moderately low intake rate; moderately slow permeability.	Generally not needed: nearly level.
Fair: too clayey.	Severe: plasticity index more than 15 percent; high shrink-swell potential.	Poor: plastic subsoil; high shrink-swell potential.	Unsuited [1]	Fair: too clayey; moderate to high shrink-swell potential.	Low seepage; nearly level.	Slopes erodible; medium to low shear strength; low to medium susceptibility to piping.	Moderately well drained; moderately slow permeability; nearly level.	High available water capacity; moderately slow permeability; moderately low intake rate.	Generally not needed: nearly level.
Good [3]	Slight where slopes are 1 to 8 percent. Moderate where slopes are 8 to 11 percent.	Good where slopes are 1 to 8 percent. Fair where slopes are 8 to 11 percent.	Fair: high content of fines; needs onsite inspection below a depth of 5 feet.	Fair: thin layer; slopes of 8 to 11 percent in some areas.	Moderately rapid permeability; material too porous.	Fair to good compaction characteristics; medium to high susceptibility to piping.	Generally not needed; well drained.	Moderate available water capacity; moderately high intake rate; severe hazard of soil blowing.	Irregular topography makes alinement difficult; severe hazard of soil blowing; medium to high susceptibility to piping.
Good	Severe: occasional flooding.	Fair: moderate shrink-swell potential; low strength.	Unsuited [1]	Good	Moderate seepage; moderate permeability.	High susceptibility to piping; fair to poor compaction characteristics; medium to low shear strength.	Moderately well drained; occasional flooding.	High available water capacity; hazard of flooding; moderate intake rate.	Generally not needed: nearly level.
Good	Moderate: moderate to high shrink-swell potential; susceptible to frost action.	Fair: moderate to high shrink-swell potential; susceptible to frost action.	Unsuited [1]	Fair: thick material; firm subsoil.	Moderate seepage.	Fair to poor compaction characteristics; medium to low shear strength; slopes erodible.	Well drained; most features favorable, except nearly level in unit Hh.	High available water capacity; severe hazard of erosion on slopes; moderate intake rate.	Susceptible to erosion; outlets lacking in places; practice not needed in unit Hh.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill: Trench type	Sanitary landfill: Area type
Hord: Hr, HrB	Slight	Moderate: moderate permeability.	Slight	Slight	Slight	Slight
Inavale: Ig, In	Moderate: rare flooding.[3]	Severe: rapid permeability; rare flooding.	Severe: loamy sand and sand texture; poor sidewall stability.	Severe: rare flooding.	Severe: seepage; rapid permeability.	Moderate: rare flooding.
Kenesaw: Kn, KnB, KnC	Slight	Moderate: moderate permeability.	Slight	Slight	Slight	Slight
Kipson: KsF	Severe: shallow over bedrock.	Severe: shallow over bedrock; moderately steep and steep.	Severe: shallow over bedrock.	Severe: shallow over bedrock.	Severe: shallow over bedrock.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
Marsh: Ma	Very severe: water on surface much of year.[2]	Very severe: water on surface much of year.	Very severe: water on surface much of year.	Very severe: water on surface much of year.	Very severe: water on surface much of year.[2]	Very severe: water on surface much of year.[2]

interpretations—Continued

Degree and kind of limitation for—Con't.		Suitability as source of—			Soil features affecting—				
Sanitary landfill—Con't. Cover material	Local roads and streets	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Good	Moderate: plasticity index less than 15 percent; low strength; susceptible to frost action.	Fair: low strength; susceptible to frost action.	Unsuited [1]	Good	Moderate seepage.	Fair to poor compaction characteristics; medium to high susceptibility to piping; medium to low shear strength; slopes erodible.	Well drained; nearly level and very gentle slopes.	High available water capacity; moderate intake rate.	Susceptible to erosion; practice not needed in unit Hr.
Poor: texture too coarse.[2]	Moderate: rare flooding.	Good	Fair: needs onsite inspection for gradation.	Poor: loamy sand texture.	High seepage; material too porous to hold water.	Fair to good compaction characteristics; medium to high susceptibility to piping.	Excessively drained.	Low available water capacity; rapid intake rate; hazard of soil blowing; rapid permeability.	Generally not needed: nearly level.
Good	Moderate: CL with plasticity index less than 15 percent; susceptible to frost action.	Fair: CL with plasticity index less than 15 percent; susceptible to frost action.	Unsuited [1]	Good	Moderate seepage.	Fair to good compaction characteristics; low to medium susceptibility to piping; slopes erodible.	Generally not needed; well drained.	High available water capacity; moderate intake rate; severe hazard of erosion in unit KnC.	Irregular topography makes alinement difficult; severe hazard of erosion.
Poor: shallow over bedrock.	Severe: shallow over bedrock.	Poor: shallow over bedrock.	Unsuited [1]	Poor: shallow; 10 to 20 inches thick.	Bedrock at depth of 10 to 20 inches; moderate seepage.	Limited material; shallow over bedrock.	Generally not needed; somewhat excessively drained.	Generally not suited; shallow over bedrock; steep.	Generally not suited: shallow over bedrock.
Poor: water on surface much of year.	Very severe; water on surface much of year.	Poor: water on surface much of year.[3]	Poor: water on surface much of year.	Poor: too wet.	Development possible in places.	Generally not needed; water on surface much of year.	Water on surface much of year; outlets not available in places.	Generally not suited.	Generally not suited.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	
					Trench type	Area type
McCook: Mb, Mc	Moderate: rare flooding.	Severe: rare flooding.	Moderate: rare flooding.	Severe: rare flooding; susceptible to frost action.	Moderate: rare flooding.	Moderate: rare flooding.
*Meadin. Mapped only with Nuckolls soils. For Nuckolls part, see Nuckolls series.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.[2]	Severe: very rapid permeability in sand and gravel.	Severe: shallow over mixed sand and gravel; sidewalls cave.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent; sidewalls cave.	Severe: rapid permeability.	Severe: rapid permeability.
Munjor: Mn, Mu	Moderate: rare flooding.[2]	Severe: moderately rapid permeability.	Moderate: rare flooding.	Severe: rare flooding.	Severe: moderately rapid permeability.	Moderate: rare flooding.
*Nuckolls: NhF, NmC, NmD, NoD2, NpD. For Hobbs part of NhF; Holdrege part of NmC, NmD, and NoD2; and Meadin part of NpD, see their respective series.	Moderate where slopes are 8 to 15 percent: moderate permeability. Severe where slopes are more than 15 percent.	Moderate where slopes are less than 7 percent: moderate permeability. Severe where slopes are more than 7 percent.	Slight where slopes are less than 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.	Moderate where slopes are 8 to 15 percent: moderate shrink-swell potential; susceptible to frost action. Severe where slopes are more than 15 percent.	Slight where slopes are less than 15 percent. Moderate where slopes are more than 25 percent.	Slight where slopes are less than 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.
Riverwash: Ra	Very severe: frequent flooding; high water table.[2]	Very severe: frequent flooding; high water table; very rapid permeability.	Very severe: frequent flooding; high water table.	Very severe: frequent flooding; high water table.	Very severe: frequent flooding; high water table.	Very severe: frequent flooding; high water table.

interpretations—Continued

Degree and kind of limitation for—Con't.		Suitability as source of—			Soil features affecting—				
Sanitary landfill—Con't. / Cover material	Local roads and streets	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Good	Moderate: plasticity index less than 15 percent, susceptible to moderate frost action; rare flooding.	Fair: plasticity index less than 15 percent; moderate susceptibility to frost action.	Unsuited [1]	Good	Moderate to high seepage.	Fair to poor compaction characteristics; high susceptibility to piping; medium to low shear strength.	Generally not needed; well drained.	High available water capacity; moderate intake rate; moderate permeability.	Generally not needed: nearly nevel.
Poor [3]	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.	Good	Good: mainly fine and medium gravel.	Poor: texture too coarse.	Shallow over coarse sand and gravel; high seepage; will not hold water in places.	Fair stability; pervious in clean sands.	Generally not needed; excessively drained.	Generally not suited.	Generally not suited.
Good [3]	Moderate: rare flooding susceptible to frost action.	Fair: low strength; susceptible to frost action.	Poor above depth of 46 inches. Good below depth of 46 inches.	Good for unit Mu. Poor for unit Mn; too sandy.	High seepage.	Fair to good compaction characteristics; medium to high susceptibility to piping; medium shear strength.	Well drained.	Moderate available water capacity; moderately high intake rate; moderately rapid permeability.	Generally not suited.
Good	Moderate where slopes are less than 15 percent: moderate shrink-swell potential; susceptible to frost action. Severe where slopes are more than 15 percent.	Fair where slopes are less than 25 percent: moderate shrink-swell potential; susceptible to frost action. Poor where slopes are more than 25 percent.	Generally unsuited.	Good where slopes are less than 8 percent. Fair where slopes are 8 to 15 percent. Poor where slopes are more than 15 percent.	Moderate permeability; low to moderate seepage.	Fair to good compaction characteristics; low to medium susceptibility to piping; medium to low shear strength.	Generally not needed; somewhat excessively drained.	High available water capacity; slopes highly erodible; moderate intake rate. Not suited where slopes are more than 9 percent.	Severe hazard of erosion.
Poor: too coarse	Very severe.	Good	Good; needs water removed; some fine and medium gravel.	Poor: texture too coarse.	Generally not suited.	Generally not suited.	Frequent flooding; high water table.	Generally not suited.	Generally not suited.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill	
					Trench type	Area type
Rough broken land: RbG	Very severe: steep and very steep.	Very severe: steep and very steep.	Very severe: steep and very steep.	Very severe: steep and very steep.	Very severe: steep and very steep.	Very severe: steep and very steep.
Rough stony land: RcF	Very severe: bedrock at surface; steep.	Very severe: bedrock at surface; steep.	Very severe: bedrock at surface; steep.	Very severe: bedrock at surface; steep.	Severe: bedrock at surface; steep.	Severe: bedrock at surface; steep.
Roxbury: Rx	Moderate: moderate permeability; rare flooding.	Moderate: moderate permeability; rare flooding.	Moderate: rare flooding.	Severe: rare flooding; susceptible to frost action.	Moderate: rare flooding.	Moderate: rare flooding.
Sandy alluvial land: Sa	Very severe: frequent flooding.[2]	Very severe: frequent flooding; rapid permeability.	Severe: frequent flooding; sidewalls cave.	Very severe: frequent flooding.	Very severe: frequent flooding; rapid permeability.	Very severe: frequent flooding; rapid permeability.
Scott: Sc	Very severe: very slow permeability; frequent ponding.	Very severe: frequent flooding.	Severe: poorly drained; frequent flooding; clayey subsoil difficult to work.	Severe: poorly drained; frequent flooding; high shrink-swell potential.	Severe: poorly drained; frequent ponding; very slow permeability; clayey.	Severe: poorly drained; frequent ponding; very slow permeability; clayey.

interpretations—Continued

Degree and kind of limitation for—Con't.		Suitability as source of—			Soil features affecting—				
Sanitary landfill—Con't.: Cover material	Local roads and streets	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Poor: slope.	Severe: steep and very steep.	Fair where slopes are less than 25 percent; moderate shrink-swell potential. Poor where slopes are more than 25 percent.	Unsuited [1]	Poor: slopes of more than 15 percent.	Moderate permeability; low to moderate seepage; steep and very steep.	Susceptible to piping; medium to low shear strength; low permeability of compacted soil.	Generally not needed; excessively drained.	Generally not suited.	Generally not suited.
Poor: limited material; slope.	Severe: bedrock at surface; steep.	Poor: bedrock at surface.	Unsuited [1]	Poor: limited material; bedrock at or near surface.	Generally not suited; bedrock at surface; steep.	Generally not suited; bedrock at surface; steep.	Generally not needed.	Generally not suited.	Generally not suited.
Good	Moderate: rare flooding; susceptible to frost action; low strength.	Fair: moderate shrink-swell potential; susceptible to frost action.	Unsuited [1]	Good	Moderate seepage.	Fair to poor compaction characteristics; high susceptibility to piping; medium compressibility.	Moderately well drained; rare flooding.	High available water capacity; moderate intake rate; moderate permeability.	Generally not needed: nearly level.
Poor: too sandy.	Severe: frequent flooding; susceptible to frost action.	Good	Good	Poor: texture too sandy.	High seepage; frequent flooding; sandy material.	High seepage; low compressibility; easy workability; erodible slopes.	Frequent flooding; good internal drainage.	Generally not suited.	Generally not needed: nearly level.
Poor: clayey.	Severe: poorly drained; frequent ponding; plasticity index more than 15 percent; high shrink-swell potential.	Poor: clayey, highly plastic material; high shrink-swell potential; poorly drained.	Unsuited [1]	Poor: very firm; clayey subsoil; poorly drained.	Low seepage; suitable for excavated pond.	Fair to poor compaction characteristics; high compressibility; low compacted permeability; low susceptibility to piping; medium to low shear strength.	Frequent ponding; slow internal drainage; outlets not available in places.	High available water capacity; needs adequate drainage; low intake rate; very slow permeability.	Generally not needed: nearly level.

TABLE 6.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with or without basements	Sanitary landfill: Trench type	Sanitary landfill: Area type
Uly: UaC, UaD	Moderate where slopes are 8 to 15 percent: moderate permeability. Severe where slopes are more than 15 percent.	Moderate where slopes are 3 to 7 percent: moderate permeability. Severe where slopes are more than 7 percent.	Slight where slopes are less than 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.	Moderate where slopes are 8 to 15 percent: moderate shrink-swell potential; susceptible to frost action. Severe where slopes are more than 15 percent.	Slight where slopes are 0 to 15 percent. Moderate where slopes are 15 to 25 percent. Severe where slopes are more than 25 percent.	Slight where slopes are 3 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are more than 15 percent.
*Valentine: VaF, VhD. For Hersh part of VhD, see Hersh series.	Moderate where slopes are 11 to 15 percent. Severe where slopes are more than 15 percent.[2]	Severe: rapid permeability; steep.	Severe: sandy texture; poor sidewall stability.	Moderate where slopes are 11 to 15 percent. Severe where slopes are more than 15 percent.	Severe: rapid permeability.	Severe: rapid permeability.
Wann: Wa, Wb	Severe: seasonal high water table at depth of 2 to 4 feet.[2]	Severe: seasonal high water table at depth of 2 to 4 feet; moderately rapid permeability.	Severe: somewhat poorly drained; seasonal high water table at depth of 2 to 4 feet.	Severe: seasonal high water table at depth of 2 to 4 feet; rare flooding; susceptible to frost action.	Severe: seasonal high water table at depth of 2 to 4 feet; moderately rapid permeability.	Severe: seasonal high water table at depth of 2 to 4 feet; moderately rapid permeability.

[1] Sand and gravel are not available, or their removal is not economically feasible because of depth.

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

Reaction refers to the acidity or alkalinity of a soil, expressed as pH. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential refers to the relative change in volume to be expected of soil material with changes in moisture content; that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils may damage building foundations, roads, and other structures. Soils that have a *high* shrink-swell potential are the most hazardous. Shrink-swell is not indicated for organic soils or certain soils which shrink markedly on drying but do not swell quickly when rewetted.

Engineering interpretations of soils

The interpretations in table 6 are based on the estimated engineering properties of soils shown in table 5, on test data for soils in this survey area and others

interpretations—Continued

Degree and kind of limitation for—Con't.		Suitability as source of—			Soil features affecting—				
Sanitary landfill—Con't. / Cover material	Local roads and streets	Road fill	Sand and gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage of cropland and pasture	Irrigation	Terraces and diversions
Good	Moderate: moderate shrink-swell potential; moderately susceptible to frost action.	Fair: moderate shrink-swell potential; moderate susceptibility to frost action.	Unsuited [1]	Good	Moderate seepage.	Fair to poor compaction characteristics; high susceptibility to piping; medium to low shear strength.	Generally not needed; well drained.	High available water capacity; moderate water intake rate; slopes highly erodible; practice not suited in unit CoF.	Slopes subject to water erosion.
Poor: too sandy.[a]	Moderate where slopes are 11 to 15 percent. Severe where slopes are more than 15 percent.	Good where slopes are 11 to 15 percent. Fair where slopes are 15 to 25 percent. Poor where slopes are more than 25 percent.	Good or fair: poorly graded.	Poor: low organic-matter content; low available water capacity; sandy texture.	Rapid permeability; high seepage.	High seepage; low compressibility; slopes erodible; easy workability.	Generally not needed; excessively drained.	Generally not suited.	Generally not suited.
Good	Severe: susceptible to frost action.	Fair: susceptible to frost action; seasonal high water table at depth of 2 to 4 feet.	Poor in upper part. Fair in places below depth of 3 feet; needs onsite inspection.	Good	Moderate seepage; suitable for dugouts.	Fair to good compaction characteristics; medium to high susceptibility to piping; low to medium compressibility;	Seasonal high water table at depth of 2 to 4 feet; moderately rapid permeability.	Moderate available water capacity; moderate or moderately high intake rate; hazard of soil blowing.	Generally not needed: nearly level.

[a] Possible hazard of pollution to underground water supply because of moderately rapid or rapid permeability.

nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Franklin County. In table 6, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture; irrigation; pond reservoir areas; embankments, dikes, and levees; and terraces and diversions. For these particular uses, table 6 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 that soil properties are generally favorable for the rated use, or in other words, that limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance. For some uses, the rating of severe is divided to obtain ratings of severe and very severe. *Very severe* means that one or more soil

TABLE 7.—*Engineering*

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

Soil name and location	Parent material	Nebraska report No. S73–	Depth	Specific gravity [1]	Mechanical analysis [2] — Percentage passing sieve— No. 10 (2.0 mm)	Mechanical analysis [2] — Percentage passing sieve— No. 40 (0.42 mm)
			In			
Campus loam: 1,584 feet west and 3,010 feet south of the northeast corner of sec. 34, T. 1 N., R. 15 W. (Modal)	Ogallala Formation.	1089	0–8	2.60	100	96
		1090	16–25	2.67	100	92
Coly silt loam: 2,376 feet south and 264 feet east of the northwest corner of sec. 22, T. 4 N., R. 14 W. (Modal)	Peoria Loess.	1097	0–5	2.63	----------	----------
		1098	10–60	2.66	----------	----------
Holdrege silt loam: 800 feet north and 500 feet east of the southwest corner of sec. 22, T. 4 N., R. 14 W. (Modal)	Peoria Loess.	1099	5–13	2.65	----------	----------
		1100	19–26	2.71	----------	----------
		1101	34–60	2.68	----------	----------
Hord silt loam: 450 feet north and 300 feet east of the southwest corner of sec. 35, T. 2 N., R. 15 W. (Modal)	Silty alluvium.	1094	6–16	2.65	----------	----------
		1095	16–29	2.66	----------	----------
		1096	41–60	2.69	----------	----------
Kenesaw silt loam: 528 feet east and 75 feet north of the southwest corner of sec. 8, T. 4 N., R. 14 W. (Modal)	Peoria Loess.	1087	0–8	2.66	----------	----------
		1088	20–60	2.65	----------	----------
McCook silt loam: 2,904 feet west and 264 feet north of the southeast corner of sec. 2, T. 1 N., R. 15 W. (Modal)	Alluvium.	1091	5–11	2.64	100	95
		1092	11–21	2.69	----------	----------
		1093	21–49	2.66	----------	----------
Munjor fine sandy loam: 1,584 feet north and 950 feet east of the southwest corner of sec. 36, T. 2 N., R. 15 W. (Modal)	Loamy alluvium.	1105	0–9	2.65	100	98
		1106	9–46	2.67	----------	100
Nuckolls silt loam: 2,376 feet west and 528 feet south of the northeast corner of sec. 28, T. 2 N., R. 15 W. (Modal)	Loveland Formation.	1102	0–9	2.61	----------	100
		1103	13–24	2.68	----------	----------
		1104	29–60	2.70	100	99

[1] Based on AASHTO Designation: T 100–70 (*1*).

[2] According to the AASHTO Designation: T 88–70 (*1*). Results by this procedure frequently may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

properties are so unfavorable for a particular use that overcoming the limitations is most difficult and costly and commonly is not practical for the rated use.

Soil suitability is rated by the terms, good, fair, and poor, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 6:

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material between depths of 18 inches and 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 affects difficulty of layout *test data*

procedures of the American Association of State Highway and Transportation Officials (AASHTO)]

Mechanical analysis [2]—Continued						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Continued		Percentage smaller than—							
No. 60 (0.25 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO [3]	Unified [4]
						Pct			
82	53	43	22	12	9	29	7	A-4(4)	CL-ML
87	66	57	41	17	13	28	9	A-4(6)	CL
100	99	92	45	26	20	39	14	A-6(10)	CL
100	99	90	42	20	13	33	10	A-4(8)	CL
100	99	92	48	29	24	36	14	A-6(10)	CL
100	99	93	62	41	37	51	29	A-7-6(18)	CH
100	98	92	49	25	16	36	12	A-6(9)	CL
100	96	86	32	19	17	31	7	A-4(8)	ML
100	97	90	40	26	22	35	13	A-6(9)	CL
100	97	91	50	26	18	34	12	A-6(9)	CL
100	97	88	46	29	22	37	14	A-6(10)	CL
100	99	92	52	27	23	37	15	A-6(10)	CL
82	69	60	28	18	14	29	9	A-4(7)	CL
100	96	87	32	17	15	29	3	A-4(8)	ML
100	97	87	19	9	9	28	1	A-4(8)	ML
95	62	48	24	15	12	26	6	A-4(5)	CL-ML
98	46	28	6	6	6	[5] NP	NP	A-4(2)	SM
99	87	75	36	25	20	37	15	A-6(10)	CL
100	88	75	41	27	22	35	14	A-6(10)	CL
97	83	72	37	25	21	32	12	A-6(9)	CL

[3] Based on AASHTO Designation: M 145-66 (*1*).

[4] Based on the Unified soil classification system (*2*).

[5] NP means nonplastic.

and construction and also the risk of erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

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, and slope; and if the floor needs to be leveled, depth to bedrock 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 amount of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewerlines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrop or big stones, and freedom from flooding or a high water table.

Dwellings, as rated in table 6, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rock.

Sanitary landfill is a method of disposing of refuse in dug trenches or on the surface of the soil. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated the ratings in table 6 apply only to a depth of about 6 feet, and therefore limitation ratings of slight or moderate may not be valid if trenches are to be much deeper than that. Even though reliable predictions can be made to a depth of 10 or 15 feet, for some soils every site should be investigated before it is selected.

Cover material for sanitary landfill should be easy to excavate and to spread over the compacted fill during both wet and dry weather. Soils that are loamy or silty and free of stones or boulders are generally better for this use than clayey soils, which may be sticky and difficult to spread, or sandy soils, which may be subject to soil blowing. Also, the soil used as final cover for the landfill should be suitable for growing plants. The A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, it is desirable to stockpile material from the A horizon for use as a surface cover for either type of landfill. Where it is necessary to bring in soil material for daily or final cover, the thickness of available material and the depth to a seasonal high water table in adjacent soils should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas, such as slope, erodibility, and potential for plant growth.

Local roads and streets, as rated in table 6, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep. Soil properties that most affect design and construction of roads and streets are load supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHTO 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 hard rock, content of stones and rock, 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. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 6 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. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate quality of the deposit.

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 the 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 affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are unfavorable factors.

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.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; need for drainage; and depth to water table or bedrock.[7]

Terraces and diversions are embankments or ridges constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth

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

to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Engineering test data

Table 7 contains engineering test data for some of the major soil series in Franklin County. These tests were made to help evaluate 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, as has been explained for table 5.

Specific gravity is the ratio of the unit weight of the soil solids to the unit weight of water. It is a measure of, and a means of expressing, the heaviness of soil. The specific gravity of the solid particles of a soil, exclusive of the void spaces, is also called the true, or real specific gravity. This property has an important influence on the density of the soil.

Formation and Classification of the Soils

This section discusses the major factors of soil formation as they have existed in Franklin County and provides the classification of the soils of the county according to the system used by the National Cooperative Soil Survey.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the disintegrated and partly weathered rock in which soil forms. It is the principal factor determining the mineral and chemical composition of the soil. About 78 percent of the soils in Franklin County formed in loess, which consists of wind-deposited clayey silt, silt, sandy silt, and silty sand of Quaternary age. The remaining soils formed in wind-deposited sand of Quaternary age; stream-deposited clayey silt, silty sand, sand, and sandy gravel of Quaternary age; weathered clay, sandy to clayey silt, sand, and sandstone of the Ogallala Formation of Tertiary age; weathered Pierre Shale of Cretaceous age; and weathered chalk and chalky shale of the Smoky Hill Chalk Member of the Niobrara Formation of Cretaceous age.

The Peoria loess and Bignell loess are the most extensive parent materials in Franklin County. These deposits blanket virtually all of the upland area and also the somewhat large terrace remnants in the Republican River valley. They are yellowish gray, pale brown, and light brownish gray clayey silt that is as much as 10 percent sand. Silica is the principal constituent. Some aluminum is present in the form of aluminosilicates. Iron oxide and the clay minerals, montmorillonite, kaolinite, and illite are the more important minor constituents. The combined thickness of these loess deposits ranges from less than a foot to 60 feet or more. Columnar jointing and the ability to stand in vertical bluffs are characteristics of these and other loess deposits. Butler, Coly, Detroit, Fillmore, Hall, Hastings, Holdrege, Scott, and Uly soils formed in Peoria loess; and Kenesaw soils formed in Peoria loess, in Bignell loess, or in combinations of both. Where Hord and Hall soils are on stream terraces, their parent material is a combination of alluvium, Peoria loess, and Bignell loess.

The Loveland Formation, an older loess underlying the Peoria loess, is the second-most extensive parent material. The area is much less extensive than the Peoria. Except for its yellowish to reddish brown color, greater oxidation, and larger percentage of sand, the Loveland loess is similar to Peoria loess and Bignell loess. It is exposed on the side slopes along streams and deeply incised drainageways. The Nuckolls soils formed on outcrops of the Loveland Formation.

Wind-deposited sand, or dune sand, is the parent material in several areas north of the Republican River. The combined extent of these deposits is estimated as about 6 square miles. Two generations of dune-sand deposition are evident; the older dune sand occurs only on the upland surface and is slightly firmer than the younger, which is confined to valleys. Hersh and Valentine soils formed in wind-deposited sand.

Stream-deposited clayey silt, silty sand, sand, and sandy gravel crop out along the lower valley sides of streams in T. 2 N. and the south half of T. 3 N. These outcrops are mantled in most places by thin wash from the higher lying loess. The Meadin soils formed in these areas. Other stream-deposited sediments underlie the floor of the Little Blue River valley, the floor of the middle reaches of nearly all tributaries to the Republican River, terraces in the Republican River valley, and the flood plain along the Republican River. Gibbon, Inavale, McCook, Munjor, Roxbury, and Wann soils formed in the more recently deposited alluvium on the flood plains. Hord and Hall soils formed in the slightly older alluvium on the high bottom-land and terrace positions.

Weathered material from the Ogallala Formation is the parent material in places where it forms the floor or side slopes of stream valleys south of the Republican River. This parent material is calcareous and has many fragments of sandstone. The Campus and Canyon soils formed in material from the Ogallala Formation.

Weathered Pierre Shale crops out in a few small areas that are north and south of the Republican River in the southwestern part of Franklin County. No areas of soils that formed in material from Pierre Shale are shown on the soil maps.

Weathered Smoky Hill Chalk is the parent material in many places in the south-central and southeastern parts of the county. The most extensive areas are in the eastern half of the area north of the Republican River valley. This chalk is silty and calcareous. It is dark yellowish orange, very pale orange, or light gray in color. Fossil clams, oysters, and Foraminifera are numerous, and the fine-textured material consists mostly of coccolith remains. Kipson soils formed in weathered Smoky Hill Chalk.

Climate

Climate is an active factor in the formation of soils. It directly influences weathering and reworking of parent material through rainfall, temperature, and wind. It indirectly affects the soil through the amount and kind of vegetation and animal life sustained.

Franklin County has a temperate, subhumid, mid-continental climate that has a wide seasonal variation. Winter temperatures below 0° F, and summer temperatures higher than 95° are common. The average annual precipitation is about 23 inches, and the average annual temperature is about 51°. Precipitation is highest during May, June, and July during thunderstorms. Occasionally there are long periods of drought in August and September. Annual precipitation ranges from about 11 inches in the driest year to about 40 inches in the wettest year. On the average 150 days per year have no killing frost. The growing season is generally from early in May to late in September or early in October. The ground is frozen for about 3 months of the year, and the frost can penetrate to a depth of 4 feet during extremely cold periods. Wind velocities are high late in fall, in winter, and spring.

The amount of rainfall in Franklin County is not enough to deeply leach the soils, except for the sandy soils. Most of the silty soils in the county have a horizon, between the depths of 1 foot to 5 feet, in which calcium carbonate has accumulated. Movement of water through the soil has carried clay particles from the surface layer to the subsoil. The depth to the calcium carbonate and the amount of clay in the subsoil have been modified by differences in slope.

Wind has influenced the formation of soils in this county. Most soils formed in loess material that was transported into the county by the wind. The sandy soils on uplands formed in material deposited by wind. Windblown soil material is continually being mixed with the surface layer. This mixing causes minor changes in the physical and chemical properties of the soils.

Alternate freezing and thawing has an effect on formation of the soils. These actions tend to flocculate the soils into aggregates, depending on the amount of moisture present. The soil-forming activities of micro-organisms increase as the soil temperature increases.

Lack of rainfall has an indirect influence on soils. It retards plant growth and, as a result, leaves the soils unprotected and subject to soil blowing and water erosion.

Plant and animal life

Trees, grasses, forbs, small burrowing animals, earthworms, micro-organisms, and other plants and animals on and in the soil are all active in the formation of soil. The kinds of plants and animals present in the soil depend upon environmental factors, such as climate, parent material, age of soil, relief, and drainage.

The native vegetation in Franklin County mainly consists of tall, mid, and short grasses and scattered trees, but grasses have been more important than trees in the processes of soil formation. Roots penetrate the soil material and increase its permeability to air and water. The decay of roots furnishes organic matter to both the surface layer and subsoil. As this organic matter decays, needed nutrients are released to plants and food is released to earthworms. Plants help to counteract leaching by bringing water and minerals upward from lower horizons.

The number and kinds of living micro-organisms are significant to the formation of soils. Such micro-organisms as nematodes, protozoa, and bacteria and also small insects such as millipedes, spiders, and mites act upon the organic matter in the soil and decompose it into stable humus from which plants obtain nutrients. Prairie dogs, gophers, badgers, and other burrowing animals aid in mixing the soil material by bringing up deep material to the surface layer. Earthworms feed on organic matter and help to mix the soil material. Worm castings increase the fertility of the soil.

Man has a great effect on soil formation through his use of the soil. His activities affect the plant and animal life. Through his management of cropland, he influences the degree and extent of erosion, the level of soil fertility, and the kind and amount of vegetation that is dominant.

Relief

Relief, or lay of the land, influences the formation of soil mainly by controlling runoff and drainage. The degree of slope, shape of the surface, and permeability of the soil determine the rate of runoff, the internal drainage, and the moisture content of the soil.

The more mature, silty soils on uplands are nearly level and very gently sloping. Runoff is slow, and most of the rainfall is absorbed. Consequently, leaching of soluble minerals and clay particles has occurred and the increase in vegetation has produced more organic matter. Thus, such soils as Holdrege soils formed and have a well-developed profile.

Depressions generally lack drainage and collect runoff from surrounding soils. In Franklin County the soils in depressions have a well-formed clayey B horizon. Scott and Fillmore soils are the major soils in the well-defined depressions and in the shallow depressions, respectively.

Moderately steep and steep soils are not so well developed as nearly level or gently sloping soils, because runoff and erosion are generally greater in the steep areas. Also, less water has been absorbed by the moderately steep and steep soils, so soil formation has been slow. Water erosion can remove soil as fast as it forms, unless the soil has a good plant cover. The Coly soils formed in areas that are gently sloping to steep.

Soils on bottom lands are affected more by internal drainage than by relief. Where the water table is high, the soil is somewhat poorly drained and the native vegetation is limited to plants that thrive in wet conditions. Gibbon and Wann soils are the main soils on wet bottom lands. Where the water table is slightly lower or the soil is occasionally flooded, the soil is moderately well drained. Roxbury and Hobbs soils are moderately well drained and are on bottom lands. Where the water table is below a depth of 5 or 6 feet, the soils are well drained. The McCook and Munjor soils are well drained and are on bottom lands. Coarse-textured soils on bottom lands have excessive drainage because water moves rapidly through the profile. Inavale soils are coarse-textured and excessively drained.

On sandy soils on uplands, relief does not affect drainage nearly so much as on silty soils, because the sandy soils have rapid permeability and there is little runoff. Soil formation on these sandy soils is influenced more by parent material and time than by relief. Valentine soils are examples of sandy soils on upland.

Time

Time is needed for the active agents of soil formation to form soil in parent material. Some soils form rapidly, and others form slowly. The length of time required to form a particular soil depends on the influence of the other four soil-forming factors.

The oldest soils in Franklin County have a distinct, well-developed B horizon. Examples of mature soils in this county are the Detroit soils which have well-developed genetic horizons. Soil materials in which the Detroit soils formed have been in place long enough for climate, plant and animal life, and relief to alter the parent material. Younger loess and alluvial deposits have been in place for a shorter length of time. Soils that formed in these materials are young or immature. They have not had time to form horizons other than a darkened surface layer. Examples of young soils in Franklin County are the Kenesaw soils on uplands and the Munjor soils on bottom lands. These soils have weakly developed horizons.

A comparison of young and mature soils shows the effect of time on soil formation. Young alluvial soils on bottom lands lack the B horizon evident in soils that formed in older deposits. Soils that formed in Recent loess have a lighter colored, thinner A horizon and a weaker B horizon than are typical of soils that formed in Peoria Loess in similar positions. In general, lime is nearer the surface in young soils than in older soils.

In some instances a soil-forming factor other than time has more effect on soil characteristics. For example, Coly soils formed on steep slopes and are weakly developed in spite of having formed in material as old as that in which the nearly level Detroit soils formed.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*3, 6*).

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. The same property or subdivisions of this property may be used in several different categories. In table 8, the soil series of Franklin County are placed in some categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Three exceptions to this are the Entisols, Histosols, and Vertisols which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Moll-i-sol).

SUBORDER: Each order is subdivided into suborders using those soil characteristics that seem to produce classes that have the greatest genetic similarity. The suborders are more narrowly defined than are the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of a water table at a shallow depth, soil climate, the accumulation of clay, iron, or organic carbon in the upper solum, cracking of soils caused by a decrease in soil moisture, and fine stratification. The names of suborders have two syllables. The last sylla-

TABLE 8.—*Classification of soil series*

Series	Family	Subgroup	Order
Butler	Fine, montmorillonitic, mesic	Abruptic Argiaquolls	Mollisols.
Campus	Fine-loamy, mixed, mesic	Typic Calciustolls	Mollisols.
Canyon	Loamy, mixed (calcareous), mesic, shallow	Ustic Torriorthents	Entisols.
Coly	Fine-silty, mixed (calcareous), mesic	Typic Ustorthents	Entisols.
Detroit	Fine, montmorillonitic, mesic	Pachic Argiustolls	Mollisols.
Fillmore	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Gibbon	Fine-silty, mixed (calcareous), mesic	Fluvaquentic Haplaquolls	Mollisols.
Hall	Fine-silty, mixed, mesic	Pachic Argiustolls	Mollisols.
Hastings	Fine, montmorillonitic, mesic	Udic Argiustolls	Mollisols.
Hersh[1]	Coarse-loamy, mixed, nonacid, mesic	Typic Ustorthents	Entisols.
Hobbs	Fine-silty, mixed, nonacid, mesic	Mollic Ustifluvents	Entisols.
Holdrege	Fine-silty, mixed, mesic	Typic Argiustolls	Mollisols.
Hord	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Inavale	Sandy, mixed, mesic	Typic Ustifluvents	Entisols.
Kenesaw	Coarse-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Kipson	Loamy, mixed, mesic, shallow	Udorthentic Haplustolls	Mollisols.
McCook	Coarse-silty, mixed, mesic	Fluventic Haplustolls	Mollisols.
Meadin	Sandy-skeletal, mixed, mesic	Udorthentic Haplustolls	Mollisols.
Munjor	Coarse-loamy, mixed (calcareous), mesic	Typic Ustifluvents	Entisols.
Nuckolls	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Roxbury	Fine-silty, mixed, mesic	Cumulic Haplustolls	Mollisols.
Scott	Fine, montmorillonitic, mesic	Typic Argialbolls	Mollisols.
Uly	Fine-silty, mixed, mesic	Typic Haplustolls	Mollisols.
Valentine	Mixed, mesic	Typic Ustipsamments	Entisols.
Wann	Coarse-loamy, mixed, mesic	Fluvaquentic Haplustolls	Mollisols.

[1] The Hersh soils are taxadjuncts to the Hersh series because the percentage of sand is higher than is defined as within the range for the series.

ble indicates the order. An example is *Aquoll* (Aqu, meaning water or wet, and *oll,* from Mollisol).

GREAT GROUP: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of soil horizons and features. The horizons used to make separations are those in which clay, carbonates, and other constituents have accumulated or have been removed; and those that have pans that interfere with growth of roots or movement of water, or both. Some features used are soil acidity, soil climate, soil composition, and soil color. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquoll (*Hapl,* meaning simple horizons, *aqu* for wetness or water, and *oll,* from Mollisols).

SUBGROUP: Great groups are subdivided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Other subgroups may have soil properties unlike those of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Argiustolls (a typical Argiustoll).

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

Physical and Chemical Analyses

Samples from soil profiles are collected for physical and chemical analyses by the Soil Conservation Service, Soil Survey Laboratory in Lincoln, Nebraska. Soils of the Hall, Hastings, Holdrege, Hord, Kenesaw, and Wann series were sampled in nearby counties, and the data were recorded in Soil Survey Investigations Report Number 5 (7).

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-alkali areas.

General Nature of the County

This section was prepared mainly for those not familiar with the county. It contains information on geology, topography and drainage, climate, water supply, transportation, industry, general facilities, and trends in soil use.

Geology

Exposed geologic units in Franklin County are of Cretaceous, Tertiary, and Quaternary age. The rocks of Cretaceous and Tertiary age crop out only where the once-continuous Quaternary deposits have been removed by the downcutting action of streams. Exposures of the Cretaceous and Tertiary rocks are common along drainageways south of the Republican River valley but are rare north of the valley.

The Cretaceous rock was deposited on the floor of a vast inland sea. Two units are recognized—the lower, or older, is the Smoky Hill Chalk Member of the Niobrara Formation, and the upper is the Pierre Shale.

The Smoky Hill Chalk is mostly light-colored, calcareous chalk and chalky shale, and the Pierre Shale is dark-colored, noncalcareous, clayey shale. Exposures of the Smoky Hill Chalk are numerous along the floor or sides of streams in the south-central and southeastern parts of the county. They occur less commonly along streams in the southwestern part of the county. The Smoky Hill Chalk is a source rock for whiting, cement, and agricultural lime.

Erosion during early and middle Tertiary time removed the Pierre Shale from the central, east-central, south-central, and southeastern parts of the county. Exposures are limited to valleys in the southwestern part of the county and are of small extent. This rock does not yield any economically important products.

The Ogallala Formation is the only unit of Tertiary age. Deposited as coalescing alluvial fans that blanketed the eroded Cretaceous rock, the Ogallala consists of uncemented sand, clayey silt and clay, silty sandstone cemented by calcium carbonate, and sandstone strongly cemented by opaline silica. Erosion removed the Ogallala from the central and east-central parts of Franklin County. Exposures of the formation are common south of the Republican River valley. Although test drilling has shown that remnants of the Ogallala are present north of the valley in the western and northern parts of the county, no exposures have been found there. Where layers of silty sandstone form ledges, they are referred to commonly as mortar beds. The silica-cemented sandstone, referred to as quartzite, has been quarried for building stone, riprap, and manufacture of abrasives.

Deposits of Quaternary age rest on the eroded surface of Ogallala remnants and elsewhere on the eroded surface of the Cretaceous rock. They consist of stream-deposited sand, silt, and clay that filled the pre-existing valleys and in places covered the divides separating those valleys; of wind-deposited clayey silt and silty sand that formed a once-continuous mantle over the entire landscape; and of the wind-reworked sand and stream-deposited silt, sand, and gravel that is the floor of the present-day valleys. The mantle of wind-deposited clayey silt and silty sand is referred to as loess, which is mostly yellowish brown and reddish brown in its lower part (the Loveland Formation) and mostly yellowish gray, pale brown, and light brownish gray in its upper part (the Peoria loess and the Bignell loess). Soils that formed during interruptions in loess deposition are preserved as dark layers within the loess sequence.

The Quaternary deposits are of great economic importance. Most of the upland soils formed in loess; terrace soils formed in loess, wind-deposited sand, or stream alluvium; and bottom land soils formed in stream alluvium. Where saturated, the coarse-textured Quaternary sediment yields water freely to wells. Sand pits have been dug into the outcrops of this coarse-textured deposit.

Physiography and Drainage

Franklin County consists of four distinct physiographic regions: a flat upland plain, a highly dissected area north of the Republican River valley, the Republican River valley, and a strongly rolling and hilly area south of that valley.

The northwestern part of the county, much of the north-central part, and some of the northeastern part constitute a nearly flat, undissected upland plain. The highest elevation, near the northwest corner of the county, is about 2,280 feet above sea level. Heading in this area, but only shallowly incised, are many tributaries to the Republican River, which flows eastward across the southern part of the county; there are also some tributaries to the Little Blue River, which flows southeastward across the northeastern part of the county. However, much of the upland plain drains to closed basins. The upland plain makes up about 33 percent of the county.

Adjoining the upland plain on the south and east is a highly dissected area. Flat-topped to somewhat rounded interstream divides are narrow projections from the undissected upland plain. The principal streams in this area are Turkey, Center, and Thompson Creeks, which are tributary streams to the Republican River within the county, and the Little Blue River, which flows out of the county at a point about 3 miles south of the northeast corner. Many smaller streams are tributaries to either the Republican River or to the other principal streams. This dissected area makes up about 41 percent of the county.

The Republican River valley is a sharply defined and remarkably straight region. It is about 200 feet deep and 1¼ to 2 miles wide. Its side slopes range from moderately steep to vertical. Bordering the side slopes in places are remnants of a stream terrace. This terrace merges with the alluvial fill in the tributary valleys and, in places, has a loess mantle. The flood plain is mostly about a mile wide, but in some places is only a half mile wide.

The Republican River meanders from one side to the other side of its flood plain, which is scarred by many former channels. Riverflow is regulated by releases of water at the Harlan County Dam, about 2 miles west of the west county line. The lowest elevation in the county, where the Republican River crosses the east county line, is about 1,737 feet above sea level. The terrace remnants and bottom land in the Republican River valley and along the tributaries of Turkey and Thompson Creeks make up about 9 percent of the county.

South of the Republican River valley is a strongly rolling and hilly area. Outcrops of the Ogallala Formation and the underlying consolidated rock are common along the numerous north- and northeast-flowing tributaries of the Republican River. This area makes up about 17 percent of the county.

The approximate elevations of the several towns in Franklin County are as follows: Bloomington, 1,848 feet; Campbell, 2,000 feet; Franklin, 1,820 feet; Hildreth, 2,175 feet; Naponee, 1,877 feet; Riverton, 1,768 feet; and Upland, 2,161 feet.

Climate [8]

Franklin County has typical continental climate. Summer is relatively warm, winter is cold, and rainfall is moderate and highly variable. The only sizable body of water near Franklin County is the Harlan County Reservoir in southeastern Harlan County. This reservoir occupies 20 to 25 square miles and is too small to have a noticeable effect on the general climate of the area.

The absence of climatological barriers to the north and south of the county permits rather large temperature changes as the wind shifts from southerly to northerly, or vice versa. The changes in wind direction are more pronounced in winter than in summer, when the large landmass to the north has warmed and is no longer a source region of very cold air. Airmasses that have their origin in the Pacific Ocean arrive in this region comparatively dry after losing moisture as they move over the Rocky Mountains. Nearly all the precipitation that falls in Franklin County is carried in on warm, moist winds from the Gulf of Mexico or the Caribbean.

Normally, more than three-fourths of the average annual precipitation falls during the growing season, April through September. Deviations from the average annual precipitation are large. In 83 years of record, the driest year, 1894, had only 10.56 inches of precipitation and the wettest year, 1915, had 40.07 inches.

In winter precipitation is generally light; most of it falls as snow. On some occasions the precipitation begins as rain and changes to snow. Slow, steady rains characterize precipitation early in spring. Nearly all precipitation in summer occurs in the form of showers and thundershowers. In fall thunderstorm activity usually decreases rapidly. Nearly every winter has one or more periods of freezing rain.

[8] Furnished by Climatology Office, Conservation and Survey Division, University of Nebraska.

Sharp temperature changes are frequent and rather large in winter. They are less frequent in summer, but days that have high temperatures are often interspersed with cooler days. However, 15 or more successive days that have high temperatures of 90° or more are not unusual.

Temperature records were begun in Franklin in 1888. The highest temperature recorded there was 116° on July 24, 1936. The lowest reading was 39° below zero on February 13, 1899.

The average date of the last 32° air temperature in spring is May 3. The average date of the first 32° air temperature in fall is October 8.

Annual free water evaporation from small lakes and farm ponds averages 53 inches, and about 75 percent of that amount occurs from May through October.

Table 9 shows the probabilities of last freezing temperatures in spring and first in fall. Table 10 shows facts about temperature and precipitation.

Water Supply

Ample water for domestic and livestock supplies can be obtained from wells throughout the Republican River valley and all the area north of the valley. Also, water sufficient for irrigation can be obtained from wells in many places in these same parts of the county. Where a large supply of water is needed, selection of a favorable well site should be based on data obtained by test drilling. The principal water-bearing material in the Republican River valley is Quaternary sand and gravel; north of the valley it consists of Quaternary sand and gravel and, in some places, the Ogallala Formation. Most wells in the valley are less than 60 feet deep, and wells in the area north of the valley range from 75 to 500 feet in depth. South of the Republican River valley, even small ground water supplies are difficult to find. In this area most of the water for livestock is obtained from impoundments and small drainageways.

According to the Nebraska Agricultural Statistics, 413 irrigation wells had been registered by January 1,

TABLE 9.—*Probabilities of last freezing temperatures in spring and first in fall*

[All data from Franklin]

Probability	Dates for given probability and temperature [1]				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 6	April 15	April 22	May 5	May 19
2 years in 10 later than	April 1	April 9	April 16	April 30	May 13
5 years in 10 later than	March 21	March 30	April 6	April 19	May 3
Fall:					
1 year in 10 earlier than	October 27	October 21	October 15	October 4	September 22
2 years in 10 earlier than	November 2	October 26	October 20	October 9	September 29
5 years in 10 earlier than	November 13	November 5	October 30	October 19	October 8

[1] All freeze data are based on temperatures measured in a standard National Weather Service thermometer shelter; the thermometers are placed approximately 5 feet above the ground; the exposure is believed to be representative of the surrounding area. Lower temperatures will exist near the ground in places and in local areas subject to extreme air drainage on calm nights.

TABLE 10.—*Temperature and precipitation*

[All data from Franklin, except as noted]

Month	Temperature				Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Two years in 10 will have at least 4 days with—[2]		Average total	One year in 10 will have—[3]		Days with 1 inch or more snow cover [4]	Average depth of snow on days with snow cover [4]
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Equal to or less than—	Equal to or more than—		
	°F	*°F*	*°F*	*°F*	*In*	*In*	*In*		*In*
January	39	13	60	–8	0.5	([5])	1.0	12	4
February	45	19	65	–3	.8	0.1	1.5	9	3
March	52	26	77	8	1.3	.1	2.5	6	6
April	66	39	84	23	2.1	.3	5.0	1	3
May	76	50	90	35	3.5	1.0	5.8	([6])	----------
June	86	60	100	47	4.4	1.0	7.2	([6])	----------
July	91	65	103	54	3.2	.7	6.3	([6])	----------
August	91	63	102	52	2.7	.9	5.2	([6])	----------
September	81	53	98	36	2.3	.5	5.1	([6])	----------
October	71	41	88	26	1.4	.1	3.1	([5])	1
November	54	27	72	12	.7	([2])	2.2	3	3
December	42	17	60	–5	.5	([2])	1.4	8	4
Year	66	39	[7] 105	[8] –16	23.4	15.8	33.2	39	3

[1] Based on period 1943–72.
[2] Computer study for period 1900–63.
[3] Based on period 1889–1972.
[4] Interpolated from surrounding stations for period 1937–66.
[5] Trace.
[6] Less than 0.5 day.
[7] Average annual highest temperature.
[8] Average annual lowest temperature.

1974. A few more than 50 of these are in the Republican River valley. All of the others are north of the valley, principally on the nearly level upland, though a few are on divides and in valleys within the highly dissected area. Water from wells is used to irrigate about 44,500 acres. An additional 7,000 acres of cropland on stream terraces and bottom land in the Republican River valley is in the Bostwich Irrigation District, which supplies water by releases from the Harlan County Reservoir, west of Franklin County.

Wetland in an undrained basin on the upland about 3 miles southwest of Hildreth is a National Wildlife Management Area.

Transportation

A railroad crosses the southern part of the county in an east-west direction. A branch of a railroad enters the county at the northeast corner near Campbell and continues west through the town of Upland and ends at Hildreth. U. S. Highway 136 crosses the southern part of the county in an east-west direction. State Highway 10 crosses the county in a north-south direction near the center of the county.

Industry

Farming has been the most important industry in Franklin County since it was first settled in 1870. Almost all farms in the county are cash grain-livestock enterprises. Most of the other industries in Franklin County are related to purchasing, processing, or selling of farm products or products related to farming. Meat packing, feed mills, fertilizer distributors, and farm machinery dealers are some of the common industries. A plastic products manufacturing plant is located in Franklin. Grain elevators are in nearly all towns of Franklin County, and these handle most of the locally grown grains that are marketed. A livestock auction market is at Franklin, where most of the livestock are marketed.

General Facilities

Towns are well distributed throughout the county. Franklin is the largest town. Other towns are Bloomington, Campbell, Hildreth, Naponee, Riverton, and Upland. Churches are located throughout the county. A weekly newspaper is published at Franklin.

The three high schools in the county are located at Franklin, Campbell, and Hildreth. Nearly every town in the county has an elementary school.

Rural electricity supplied by the Rural Electric Administration serves all rural areas of Franklin County. Franklin has its own electric powerplant. Natural gas is available to all towns in the county.

Outdoor recreation is provided by nearby Harlan County Reservoir. The Republican River provides many recreational areas. Franklin has a golf course and racetrack.

Trends in Farming

According to the Nebraska Agricultural Statistics, the trend in farming is to larger operating units. The total number of farms decreased from 825 in 1959 to 620 in 1973. The average size of farms increased from 425 acres in 1959 to 518 acres in 1969. The total acreage of cropland has decreased because marginal cropland has been reseeded to native grasses. The amount of total cropland irrigated increased from 22,686 acres in 1959 to 33,849 acres in 1969. The number of irrigation wells increased from 205 on January 1, 1958 to 413 on January 1, 1974.

Corn is the most important crop grown in the county. In 1957, 14,810 acres of irrigated corn and 13,040 acres of dryland corn were harvested. In 1973 the acres of irrigated corn harvested had increased to 36,000 and the acres of dryland corn had decreased to 5,500.

Acreage of dryland grain sorghum decreased from 39,570 acres in 1957 to 36,000 acres in 1973. Irrigated acres of this crop decreased from 3,610 in 1957 to 3,000 in 1973.

The acreage of winter wheat has decreased from 36,090 acres in 1957 to 33,200 acres in 1973. This is due primarily to acreage controls.

The acres of irrigated alfalfa increased slightly, from 1,650 acres in 1957 to 1,800 acres in 1973. Dryland acreage of alfalfa has decreased from 10,550 acres in 1957 to 5,200 acres in 1973.

Soybeans and oats are minor crops in Franklin County.

Cattle on farms in Franklin County consists of cow and calf herds on rangeland in combination with a drylot fattening program. Cattle on farms increased from 35,710 in 1957 to 50,200 in 1973. The number of milk cows decreased from 3,810 in 1957 to 810 in 1973. The number of hogs on farms increased significantly from 8,140 in 1957 to 30,200 in 1973.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Buried soil. A developed soil that was once exposed but is now overlain by a more recently formed soil.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above 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 bases of steep slopes.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crops production, or a crop grown between trees and vines in orchards and vineyards.

Depth, soil. The total thickness of soil material that plant roots can penetrate readily to obtain water and plant nutrients. It is the depth to a layer that differs sufficiently from the overlying material in physical or chemical properties to prevent or seriously retard the growth of roots. In this survey, the classes of soil depth are—

	Inches
Very shallow	0 to 10
Shallow	10 to 20
Moderately deep	20 to 40
Deep	More than 40

Dryfarming. Production of crops that require some tillage in a subhumid or semi-arid region, without irrigation. Usually involves periods of fallow, during which time enough moisture accumulates in the soil to allow production of a cultivated crop.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

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.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

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 a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Organic matter, soil. The organic fraction of the soil that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population. In this survey, percentages of organic matter are expressed as—

	Percent
Very low	Less than 0.5
Low	0.5 to 1.0
Moderately low	1.0 to 2.0
Moderate	2.0 to 4.0
High	4.0 to 8.0

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

Profile, soil. A vertical section of the soil extending through all its horizons and 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 described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. Slope classes and percent of slope are expressed in this survey as—

	Percent
Nearly level	0 to 1
Very gently sloping	1 to 3
Gently sloping	3 to 6
Strongly sloping	6 to 9 or 11
Steep	9 or 11 to 30
Very steep	More than 30

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Windbreak. Any shelter that provides protection from the wind.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, a range site, or a windbreak suitability group, read the introduction to the section it is in for general information about its management.

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Page	Capability unit Irrigated Symbol	Page	Range site Name	Page	Windbreak suitability group Number
Br	Broken alluvial land-------------	9	VIw-7	39	-------	--	Silty Overflow	52	10
Bu	Butler silt loam, 0 to 1 percent slopes------------------------	10	IIw-2	34	IIw-2	44	Clayey	53	2
CaF	Campus complex, 9 to 30 percent slopes------------------------	11	VIe-1	38	-------	--	Limy Upland	54	10
CnF	Canyon-Campus loams, 9 to 30 percent slopes-----------------	12	VIs-4	39	-------	--	-----------------	--	10
	Canyon soil------------------	--	-------	--	-------	--	Shallow Limy	54	-----
	Campus soil------------------	--	-------	--	-------	--	Limy Upland	54	-----
CoD2	Coly-Uly silt loams, 3 to 9 percent slopes, eroded---------	12	IVe-9	38	IVe-6	47	-----------------	--	5
	Coly soil--------------------	--	-------	--	-------	--	Limy Upland	54	-----
	Uly soil---------------------	--	-------	--	-------	--	Silty	53	-----
CoF	Coly-Uly silt loams, 9 to 30 percent slopes-----------------	13	VIe-9	39	-------	--	-----------------	--	10
	Coly soil--------------------	--	-------	--	-------	--	Limy Upland	54	-----
	Uly soil---------------------	--	-------	--	-------	--	Silty	53	-----
De	Detroit silt loam, 0 to 1 percent slopes-----------------	13	IIc-1	34	I-2	41	Silty Lowland	53	4
Fm	Fillmore silt loam, 0 to 1 percent slopes-----------------	14	IIIw-2	36	IIIw-2	46	Clayey Overflow	52	2
Gb	Gibbon silt loam, 0 to 2 percent slopes-----------------	14	IIw-4	35	IIw-6	44	Subirrigated	52	2
GcF	Gravelly land complex, 3 to 30 percent slopes-----------------	15	VIIs-4	40	-------	--	Shallow to Gravel	54	10
Ha	Hall silt loam, 0 to 1 percent slopes-----------------	15	IIc-1	34	I-4	41	Silty	53	4
Hb	Hall silt loam, terrace, 0 to 1 percent slopes-----------------	15	IIc-1	34	I-4	41	Silty Lowland	53	1
Hc	Hastings silt loam, 0 to 1 percent slopes-----------------	17	IIc-1	34	I-4	41	Silty	53	4
HdC	Hersh-Valentine complex, 1 to 6 percent slopes-----------------	17	IIIe-3	36	IIIe-8	45	-----------------	--	7
	Hersh soil------------------	--	-------	--	-------	--	Sandy	53	-----
	Valentine soil---------------	--	-------	--	-------	--	Sands	53	-----
HdD	Hersh-Valentine complex, 6 to 11 percent slopes-----------------	17	IVe-3	37	IVe-8	47	-----------------	--	7
	Hersh soil------------------	--	-------	--	-------	--	Sandy	53	-----
	Valentine soil---------------	--	-------	--	-------	--	Sands	53	-----
Hf	Hobbs silt loam, occasionally flooded, 0 to 2 percent slopes-	18	IIw-3	35	IIw-6	44	Silty Overflow	52	1
Hh	Holdrege silt loam, 0 to 1 percent slopes-----------------	19	IIc-1	34	I-4	41	Silty	53	4
HhB	Holdrege silt loam, 1 to 3 percent slopes-----------------	19	IIe-1	34	IIe-4	42	Silty	53	4
HhC	Holdrege silt loam, 3 to 6 percent slopes-----------------	19	IIIe-1	36	IIIe-4	44	Silty	53	4
HhD	Holdrege silt loam, 6 to 9 percent slopes-----------------	20	IVe-1	37	IVe-4	46	Silty	53	4
HnD2	Holdrege and Uly soils, 3 to 9 percent slopes, eroded---------	20	IVe-8	38	IVe-3	46	Silty	53	4
Hr	Hord silt loam, terrace, 0 to 1 percent slopes-----------------	20	IIc-1	34	I-6	41	Silty Lowland	53	1

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page	Windbreak suitability group Number
HrB	Hord silt loam, terrace, 1 to 3 percent slopes	20	IIe-1	34	IIe-6	43	Silty Lowland	53	1
Ig	Inavale loamy sand, 0 to 3 percent slopes	21	IVe-5	37	IIIe-11	46	Sandy Lowland	52	3
In	Inavale fine sandy loam, 0 to 3 percent slopes	21	IIIe-3	36	IIIe-11	46	Sandy Lowland	52	3
Kn	Kenesaw silt loam, 0 to 1 percent slopes	22	IIc-1	34	I-6	41	Silty	53	4
KnB	Kenesaw silt loam, 1 to 3 percent slopes	22	IIe-1	34	IIe-6	43	Silty	53	4
KnC	Kenesaw silt loam, 3 to 6 percent slopes	22	IIIe-1	36	IIIe-6	44	Silty	53	4
KsF	Kipson complex, 9 to 30 percent slopes	22	VIs-4	39	-------	--	Shallow Limy	54	10
Ma	Marsh	23	VIIIw-7	40	-------	--	-----------------	--	10
Mb	McCook fine sandy loam, 0 to 2 percent slopes	24	IIe-3	34	IIe-5	42	Silty Lowland	53	3
Mc	McCook silt loam, 0 to 2 percent slopes	24	I-1	33	I-6	41	Silty Lowland	53	1
Mn	Munjor loamy fine sand, 0 to 2 percent slopes	25	IIIe-5	36	IIIe-10	45	Sandy Lowland	52	3
Mu	Munjor fine sandy loam, 0 to 2 percent slopes	25	IIe-3	34	IIe-8	43	Sandy Lowland	52	3
NhF	Nuckolls-Hobbs complex, 9 to 30 percent slopes	26	VIe-1	38	-------	--	-----------------	--	10
	Nuckolls soil	--	-------	--	-------	--	Silty	53	-----
	Hobbs soil	--	-------	--	-------	--	Silty Overflow	52	-----
NmC	Nuckolls and Holdrege silt loams, 3 to 6 percent slopes	26	IIIe-1	36	IIIe-4	44	Silty	53	4
NmD	Nuckolls and Holdrege silt loams, 6 to 9 percent slopes	26	IVe-1	37	IVe-4	46	Silty	53	4
NoD2	Nuckolls and Holdrege soils, 3 to 9 percent slopes, eroded	26	IVe-8	38	IVe-3	46	Silty	53	4
NpD	Nuckolls and Meadin soils, 9 to 30 percent slopes	27	VIe-1	38	-------	--	-----------------	--	10
	Nuckolls soil	--	-------	--	-------	--	Silty	53	-----
	Meadin soil	--	-------	--	-------	--	Shallow to Gravel	54	-----
Ra	Riverwash	27	VIIIw-7	40	-------	--	-----------------	--	10
RbG	Rough broken land, loess, 20 to 60 percent slopes	27	VIIe-9	40	-------	--	Thin Loess	54	10
RcF	Rough stony land, 15 to 30 percent slopes	27	VIIs-3	40	-------	--	Shallow Limy	54	10
Rx	Roxbury silt loam, 0 to 2 percent slopes	28	I-1	33	I-6	41	Silty Lowland	53	1
Sa	Sandy alluvial land	29	VIIw-7	40	-------	--	Sands	53	10
Sc	Scott silt loam, 0 to 1 percent slopes	29	IVw-2	38	-------	--	-----------------	--	10
UaC	Uly silt loam, 3 to 6 percent slopes	30	IIIe-1	36	IIIe-6	44	Silty	53	4
UaD	Uly silt loam, 6 to 11 percent slopes	30	IVe-1	37	IVe-6	47	Silty	53	4
VaF	Valentine loamy sand, hilly	30	VIIe-5	39	-------	--	Choppy Sands	53	10
VhD	Valentine-Hersh complex, 11 to 30 percent slopes	31	VIe-5	39	-------	--	-----------------	--	10
	Valentine soil	--	-------	--	-------	--	Sands	53	-----
	Hersh soil	--	-------	--	-------	--	Sandy	53	-----
Wa	Wann fine sandy loam, 0 to 2 percent slopes	32	IIw-6	35	IIw-8	44	Subirrigated	52	2
Wb	Wann silt loam, 0 to 2 percent slopes	32	IIw-4	35	IIw-8	44	Subirrigated	52	2

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