United States
Department of
Agriculture

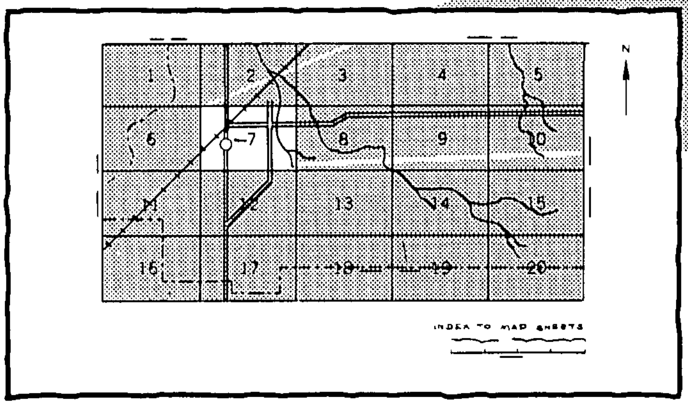
Soil
Conservation
Service

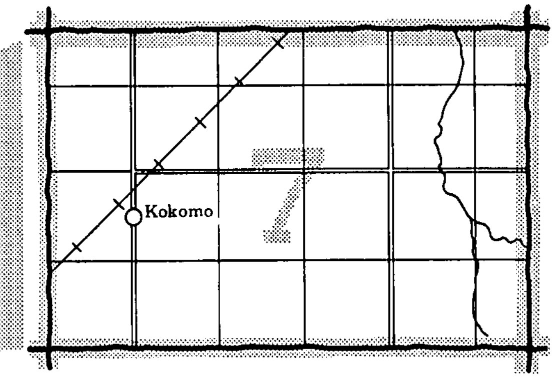
In cooperation with
Kansas Agricultural
Experiment Station

Soil Survey of Phillips County, Kansas

HOW TO USE

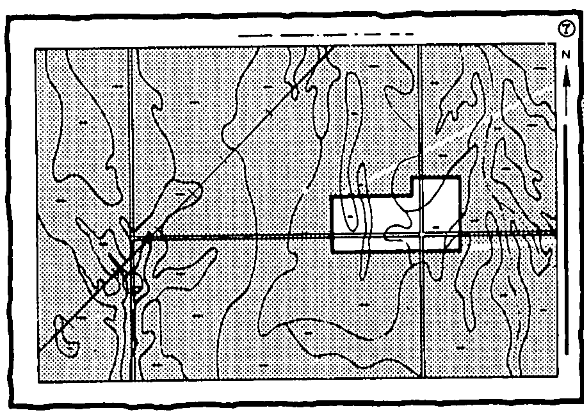
1. Locate your area of interest on the "Index to Map Sheets."

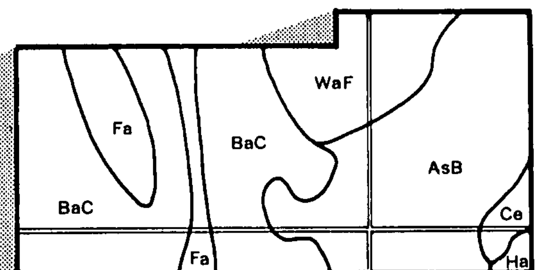




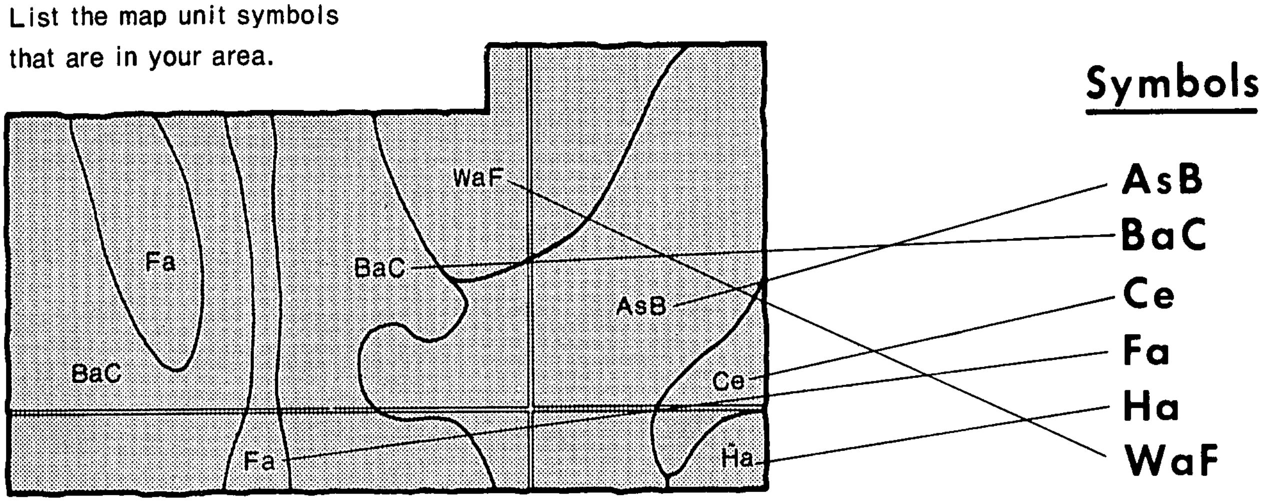
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



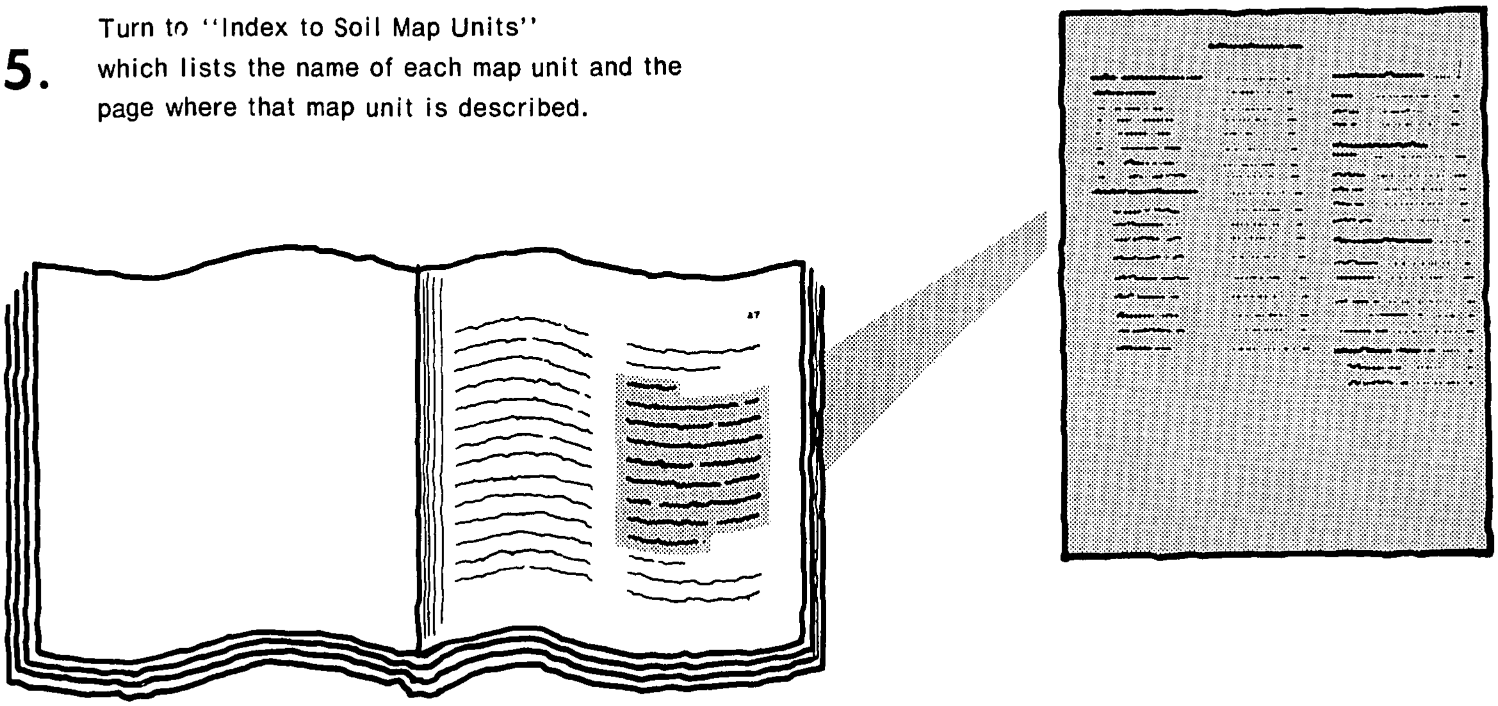


4. List the map unit symbols that are in your area.

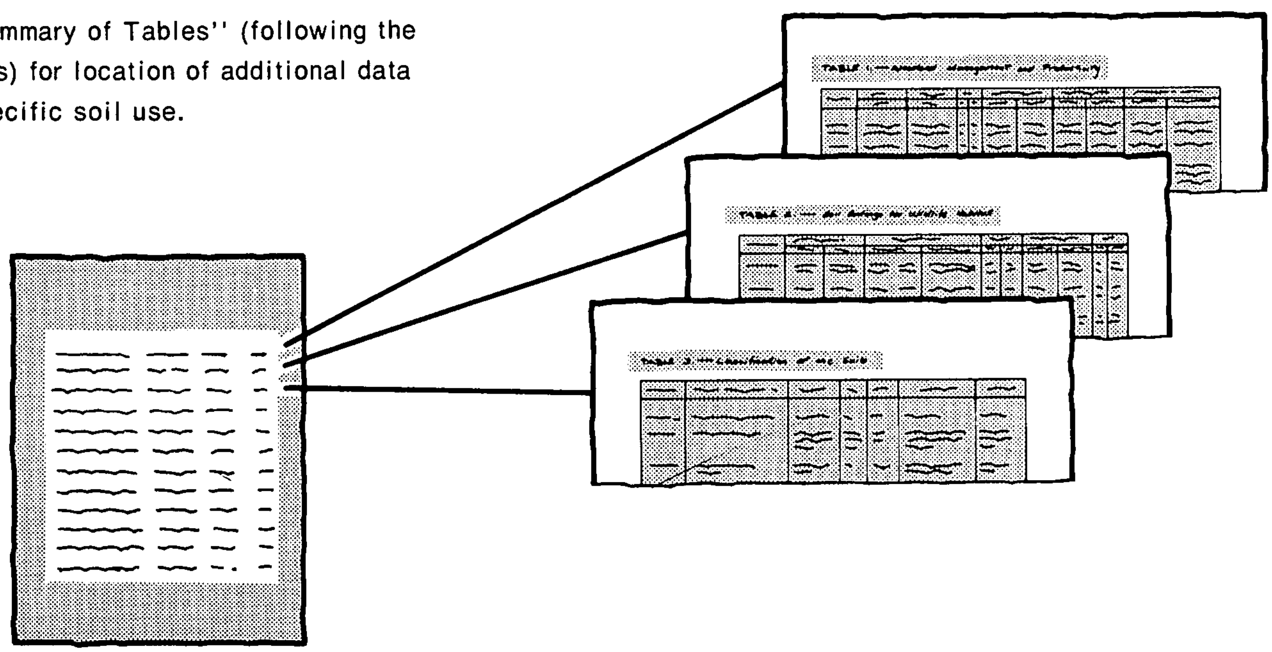


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. 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, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed during the period 1980-1984. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Phillips County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Trees planted as windbreaks around a ranch headquarters in Phillips County.

Contents

Soil Series

Issued September 1987

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Phillips County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

John W. Tippie
State Conservationist
Soil Conservation Service

Soil Survey of
Phillips County, Kansas

By Cecil D. Palmer and Vernon L. Hamilton, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Kansas Agricultural Experiment Station

General Nature of the County

PHILLIPS COUNTY is in the north-central part of Kansas (fig. 1). It has an area of 572,576 acres, or about 895 square miles. In 1980, it had a population of 7,406. More than half of the people live in Phillipsburg, the county seat, and in Logan. The county was organized in 1872.

Phillips County is in the Rolling Plains and Breaks major land resource area (*3*). The soils generally are deep or moderately deep, are nearly level to strongly sloping, and have a silty or loamy subsoil. The highest elevation, about 2,320 feet above sea level, is in the northwestern part of the county, near Prairie View. The lowest, about 1,650 feet, is in an area along the North Fork Solomon River. This area is in the eastern part of the county, near Kirwin.

Most of Phillips County is drained by the North Fork Solomon River and its tributaries, which flow in a southeastern and eastern direction across the county (fig. 2). The northwest corner is drained by Prairie Dog Creek.

Many upland areas do not have enough water for domestic uses and livestock. Rural water districts help to distribute water to these areas. The water supply generally is better in the valleys along the major streams. Some of the soils in these valleys are irrigated. The water for irrigation is drawn from wells or local streams or is surface water impounded by dams, such as Sebelius Lake.

Farming, ranching, and services related to these activities are the main enterprises. About 48 percent of the county is rangeland, 47 percent is cropland, and 5 percent is small water areas, farmsteads, roads, and land developed for urban and other uses (*8*). Wheat and grain sorghum are the principal crops.

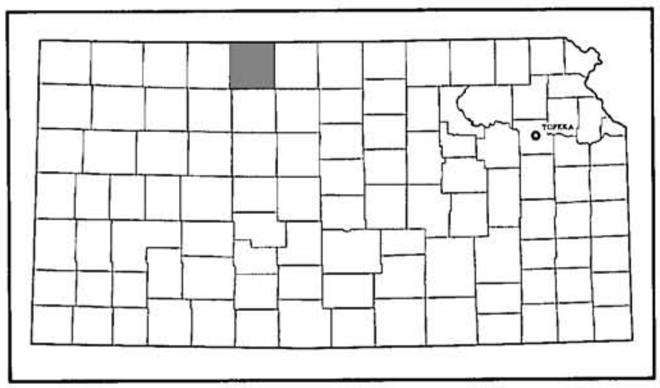


Figure 1.—Location of Phillips County in Kansas.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate in Phillips County is typical continental, as can be expected of a location in the interior of a large landmass in the middle latitudes. This climate is characterized by large daily and annual variations in temperature. Winters are cold because of frequent outbreaks of polar air. The cold temperatures prevail from December to February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops grown in the county. Spring and fall are relatively short.

Phillips County is in the path of a fairly dependable current of moisture-laden air from the Gulf of Mexico. It is to the east of the strong rain-shadow effects of the Rocky Mountains. As a result, the annual amount of precipitation is marginal for cropping year after year. Precipitation is in the form of showers and thunderstorms that can be extremely heavy at times. Winds are relatively high and can cause significant soil loss and crop damage in the drier years.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Phillipsburg in the period 1941 to 1970. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 30.7 degrees F, and the average daily minimum temperature is 18.4 degrees. The lowest temperature on record, which occurred at Phillipsburg on February 12, 1899, is -32 degrees. In summer the average temperature is 77.2 degrees, and the average daily maximum temperature is 90.4 degrees. The highest recorded temperature, which occurred at Phillipsburg on July 24, 1936, is 120 degrees.

The total annual precipitation is 24.69 inches. Of this, 19.55 inches, or about 79 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15.25 inches. The heaviest 1-day rainfall on record was 7.5 inches at Phillipsburg on September 18, 1919.

The average seasonal snowfall is 28 inches. The highest recorded seasonal snowfall is 61.8 inches. On the average, 36 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The sun shines 77 percent of the time possible in summer and 67 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 11 miles per hour, in spring.

Tornadoes and severe thunderstorms strike occasionally. These storms are usually local in extent and of short duration, so that the risk of damage is small. Hail falls during warm periods. The hailstorms are infrequent, however, and are of local extent. They cause less crop damage in this county than in western Kansas.

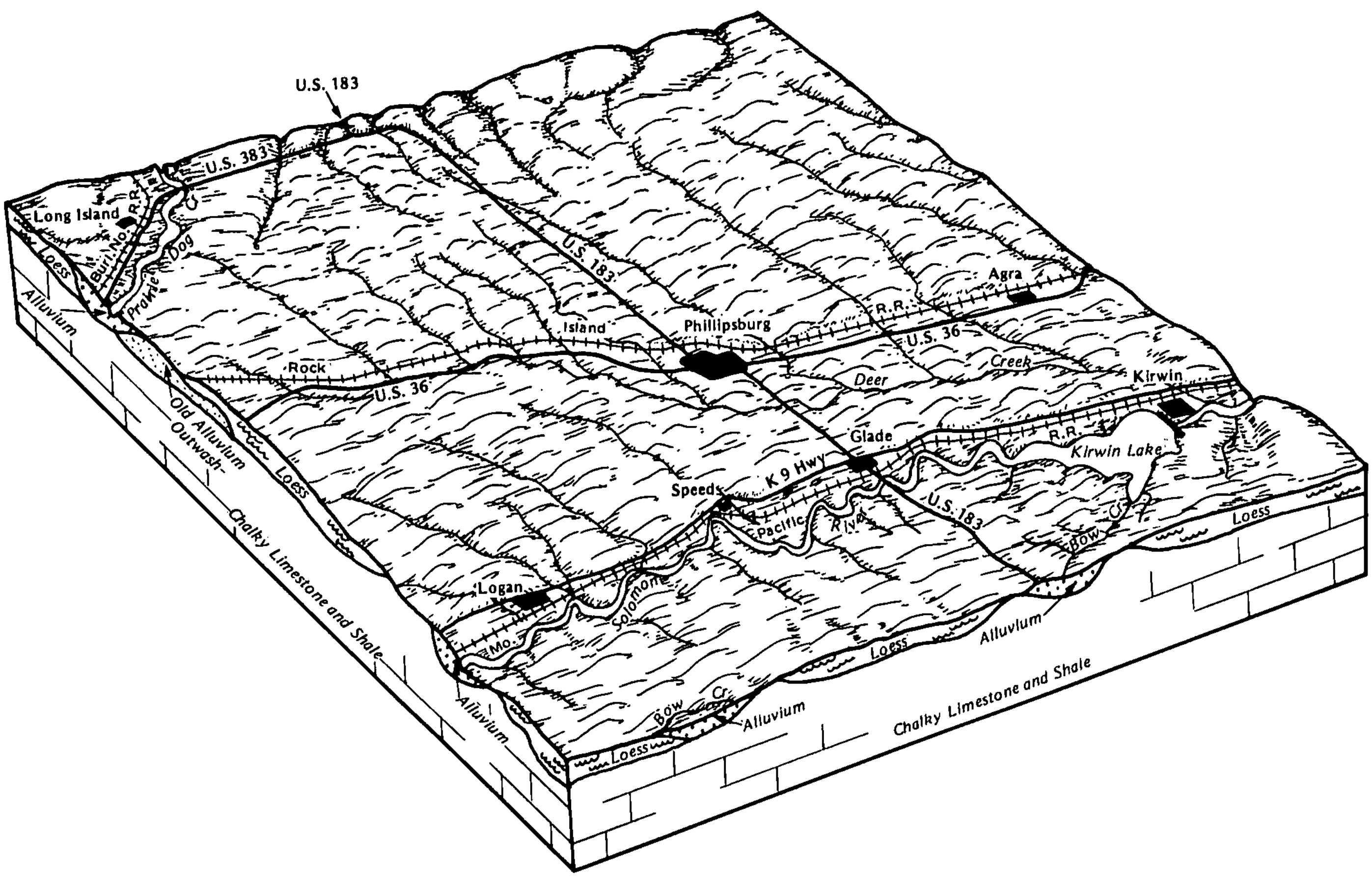


Figure 2.—General pattern of drainage, relief, and geology in Phillips County.

Natural Resources

Soil is the most important natural resource in the county. It provides a growing medium for field crops and range plants. Other natural resources are chalky shale and limestone, sand, gravel, and oil. The chalky material and gravel are used for road surfacing. Opaline sandstone and volcanic ash are available in some areas.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Map Unit Descriptions

This section describes the map units in the survey area at two levels of detail. The general soil map units, called soil associations, are described first and then the detailed map units. Most of the general soil map units represent the soils of major extent in the survey area. The detailed map units represent all of the named soils in the survey area.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

1. Holdrege-Uly Association

Deep, nearly level to moderately steep, well drained soils that have a silty clay loam or silt loam subsoil; on uplands

This association is on broad ridges and side slopes that are dissected by narrow drainageways. Slopes range from 0 to 20 percent.

This association makes up about 35 percent of the county. It is about 50 percent Holdrege soils, 20 percent Uly soils, and 30 percent minor soils (fig. 3).

The nearly level and gently sloping Holdrege soils formed in loess on broad ridges. Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is grayish brown, friable silty clay loam; the next part is pale brown, firm silty clay loam; and the lower part is pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The moderately sloping to moderately steep Uly soils formed in loess on side slopes along drainageways. Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 10 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The minor soils in this association are the Anselmo, Hobbs, Penden, Roxbury, and Wakeen soils. Anselmo soils are on ridgetops and stream terraces. They are more sandy than the major soils. The calcareous Penden soils are on side slopes. Roxbury and Hobbs soils are on flood plains along drainageways. The moderately deep Wakeen soils are on the lower side slopes.

Most of this association is used for cultivated crops. Some moderately sloping to moderately steep areas along entrenched drainageways are used as range. Grain sorghum, wheat, and alfalfa are the main crops. Controlling erosion, maintaining tilth and fertility, and conserving moisture are concerns in managing the cultivated areas. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

2. Hord-Roxbury Association

Deep, nearly level, well drained soils that have a silt loam subsoil; on stream terraces and flood plains

This association is on terraces and flood plains along the major streams. Slopes range from 0 to 2 percent.

This association makes up about 4 percent of the county. It is about 60 percent Hord soils, 28 percent Roxbury soils, and 12 percent minor soils.

The Hord soils formed in silty alluvium on stream terraces. They have a thin mantle of loess in some areas. Typically, the surface layer is dark grayish brown

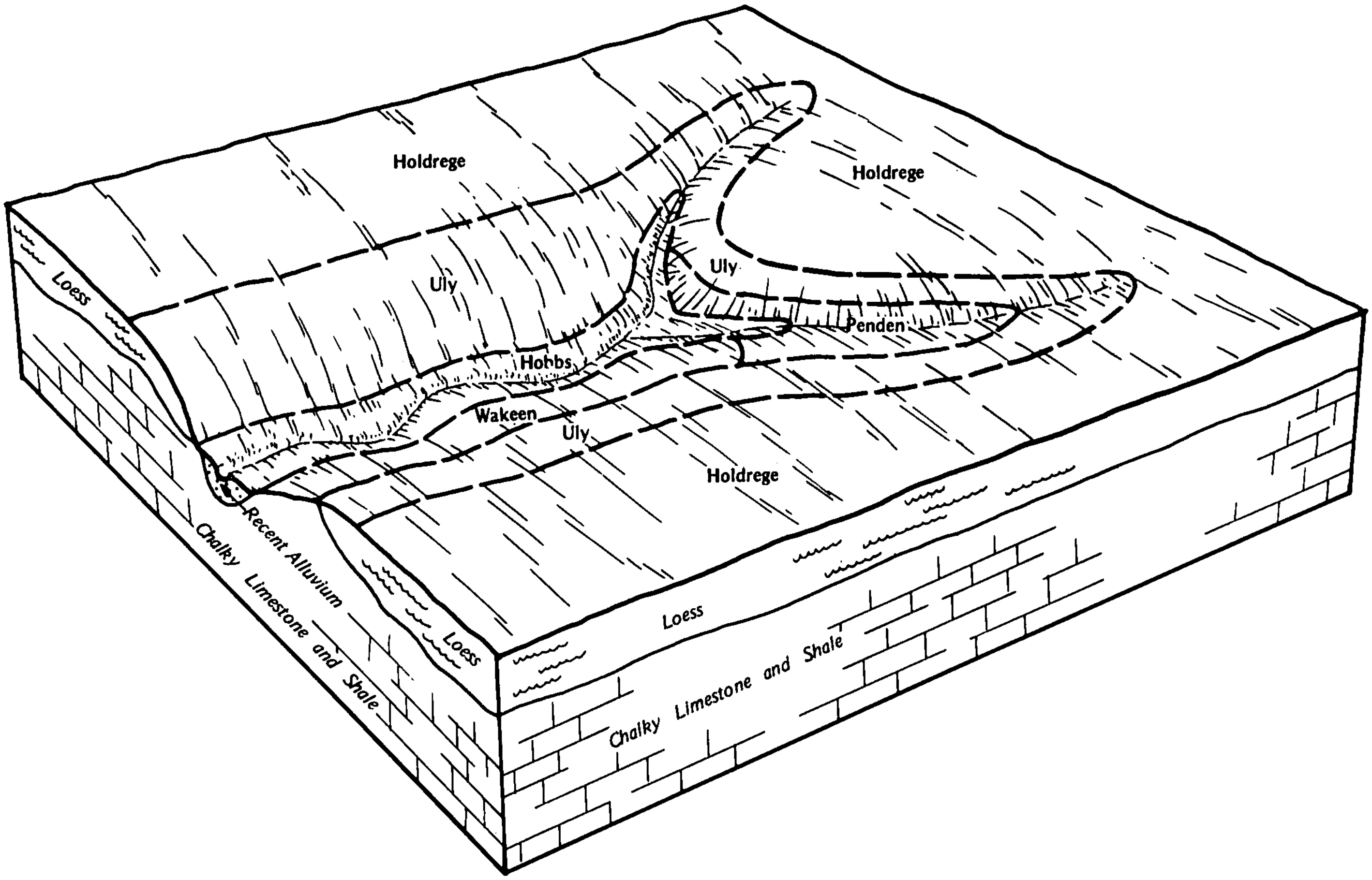


Figure 3.—Pattern of soils and parent material in the Holdrege-Uly association.

silt loam about 8 inches thick. The subsurface layer is grayish brown silt loam about 12 inches thick. The subsoil is grayish brown, friable silt loam about 16 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam.

The Roxbury soils formed in silty alluvium on stream terraces and flood plains. Typically, the surface layer is grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is dark grayish brown, calcareous silt loam about 30 inches thick. The next layer is grayish brown, friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam.

The minor soils in this association are the Detroit and McCook soils. The moderately well drained Detroit soils are on terraces. McCook soils have a dark surface soil that is thinner than that of the Roxbury soils. They are on the lower terraces near stream channels.

This association is used almost exclusively for cultivated crops. Most of the acreage is irrigated. Corn, grain sorghum, wheat, and alfalfa are the main crops. Deciduous trees grow along most of the stream channels. The areas along the channels are used as wildlife habitat. Controlling floodwater, managing crop residue, properly distributing irrigation water, and maintaining tilth and fertility are the main concerns in managing the cultivated areas.

3. Roxbury-Munjor-McCook Association

Deep, nearly level, well drained soils that have a silt loam or sandy loam subsoil; on stream terraces and flood plains

This association is on terraces and flood plains along the major streams. Slopes range from 0 to 2 percent.

This association makes up about 8 percent of the county. It is about 35 percent Roxbury soils, 16 percent Munjor soils, 14 percent McCook soils, and 35 percent minor soils.

The Roxbury soils formed in silty alluvium on stream terraces and flood plains. Typically, the surface layer is grayish brown, calcareous silt loam about 8 inches thick.

The subsurface layer is dark grayish brown, calcareous silt loam about 30 inches thick. The next layer is grayish brown, friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam.

The Munjor soils formed in loamy alluvium on flood plains. Typically, the surface layer is grayish brown sandy loam about 6 inches thick. The next layer is light brownish gray, very friable sandy loam about 5 inches thick. The upper part of the substratum is light brownish gray fine sandy loam. The lower part to a depth of about 60 inches is pale brown sand.

The McCook soils formed in silty alluvium on stream terraces. Typically, the surface layer is grayish brown, calcareous silt loam about 5 inches thick. The subsurface layer also is grayish brown, calcareous silt loam. It is about 6 inches thick. The next layer is light brownish gray, very friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam.

The minor soils in this association are the Anselmo, Armo, Bridgeport, Hord, and Inavale soils. The loamy Armo and Anselmo soils are on uplands and are not subject to flooding. The sandy Inavale soils are on flood plains. Bridgeport and Hord soils are on the higher terraces.

This association is used mainly for cultivated crops. Some small areas are used as range. A few areas are irrigated. Wheat, grain sorghum, alfalfa, and corn are the main crops. Controlling flooding and maintaining fertility and tilth are concerns in managing the cultivated areas. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

Cottonwood and other deciduous trees grow along most of the stream channels. The areas along these channels are used as wildlife habitat and as range. An area adjacent to and south of Kirwin Lake is used for recreational activities, including camping and hunting. The Kirwin National Wildlife Refuge is part of this association. It is used for waterfowl protection.

4. Uly-Holdrege-Penden Association

Deep, gently sloping to moderately steep, well drained soils that have a silty clay loam, silt loam, or loam subsoil; on uplands

This association is on ridgetops and side slopes that are dissected by drainageways and creeks. Slopes range from 1 to 20 percent.

This association makes up about 32 percent of the county. It is about 30 percent Uly soils, 25 percent Holdrege soils, 15 percent Penden soils, and 30 percent minor soils (fig. 4).

The moderately sloping to moderately steep Uly soils formed in loess on narrow ridges and the upper side slopes along drainageways. Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 10 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The gently sloping Holdrege soils formed in loess on broad ridges. Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is grayish brown, friable silty clay loam; the next part is pale brown, firm silty clay loam; and the lower part is pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The moderately sloping Penden soils formed in calcareous, loamy old alluvium on side slopes. Typically, the surface layer is grayish brown, calcareous loam about 9 inches thick. The subsoil is friable, calcareous loam about 24 inches thick. The upper part is pale brown, and the lower part is very pale brown. The substratum to a depth of about 60 inches is very pale brown, calcareous loam.

The minor soils in this association are the Anselmo, Campus, Canlon, Hobbs, Roxbury, Valentine, and Wakeen soils. Anselmo soils are on ridgetops and the upper side slopes. They are more sandy than the major soils. The moderately deep Campus and shallow Canlon soils are on side slopes. Hobbs and Roxbury soils are on flood plains along drainageways. The sandy, moderately sloping to moderately steep Valentine soils are on hills and in swales. The moderately deep Wakeen soils are on ridgetops and side slopes.

This association is used mainly as range. Some areas are used for cultivated crops. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range. Controlling erosion and maintaining fertility are concerns in managing the cultivated areas.

5. Holdrege-Uly-Wakeen Association

Deep and moderately deep, gently sloping to moderately steep, well drained soils that have a silty clay loam or silt loam subsoil; on uplands

This association is on broad ridges and side slopes that are dissected by drainageways. A few chalky rock outcrops are in the moderately steep areas. Slopes range from 1 to 20 percent.

This association makes up about 12 percent of the county. It is about 47 percent Holdrege soils, 18 percent Wakeen soils, 15 percent Uly soils, and 20 percent minor soils (fig. 5).

The deep, gently sloping Holdrege soils formed in loess on broad ridges. Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is grayish brown, friable silty clay loam; the next part is pale brown, firm silty clay loam; and the

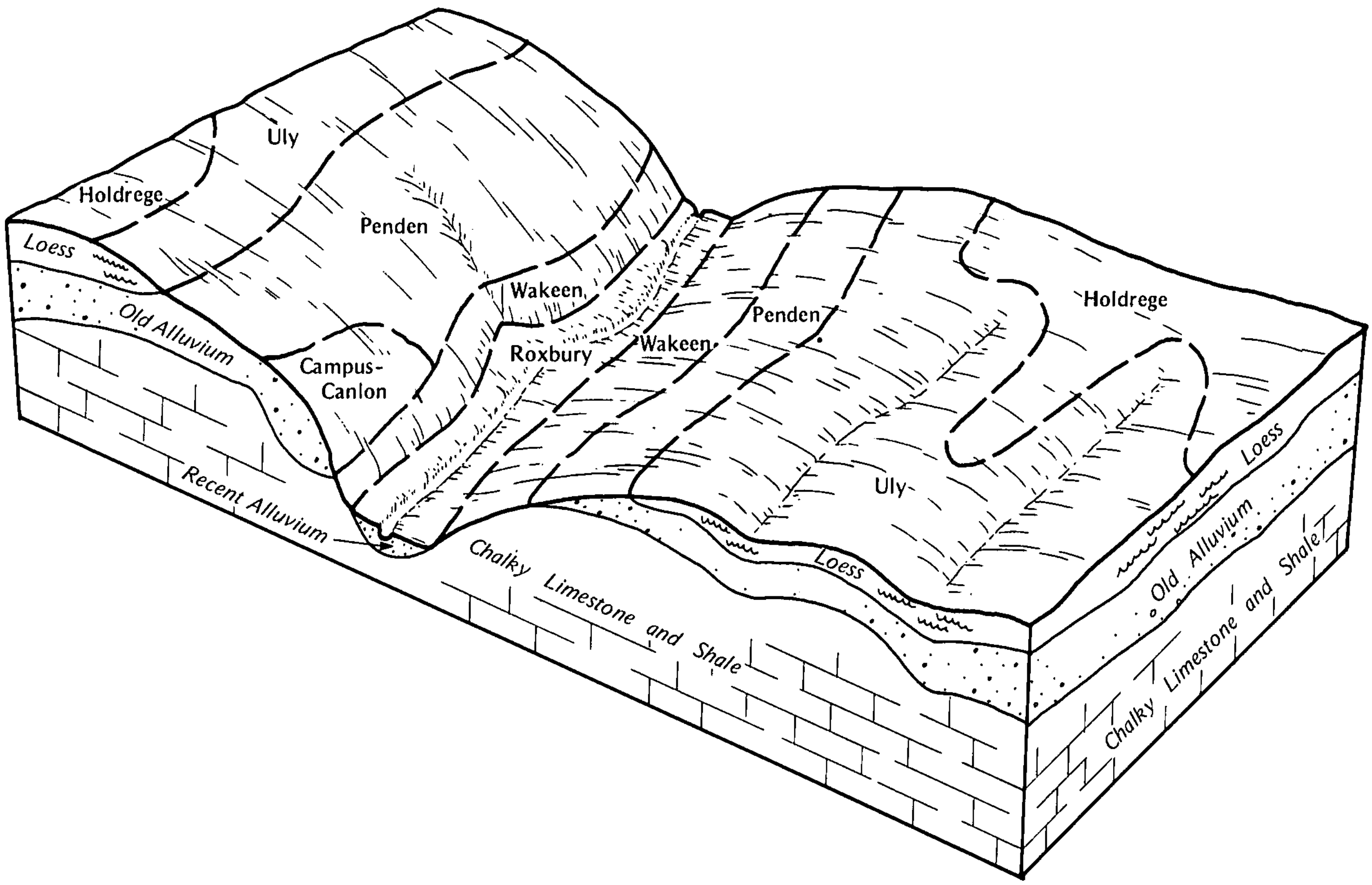


Figure 4.—Pattern of soils and parent material in the Uly-Holdrege-Penden association.

lower part is pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The deep, moderately sloping to moderately steep Uly soils formed in loess on the upper side slopes along drainageways. Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsoil is about 10 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The moderately deep, strongly sloping and moderately steep Wakeen soils formed in chalky sediments on ridges and the lower side slopes along drainageways. Typically, the surface layer is dark grayish brown, calcareous silt loam about 12 inches. The subsoil is friable, calcareous silt loam about 16 inches thick. The upper part is pale brown, and the lower part is very pale brown. The substratum is very pale brown, calcareous silt loam about 9 inches thick. White chalky limestone is at a depth of about 37 inches.

The minor soils in this association are the Anselmo, Armo, Brownell, Heizer, Munjor, Penden, and Roxbury soils. The loamy Anselmo soils are on ridgetops and stream terraces. The loamy Armo soils are on foot slopes and the lower side slopes. The moderately deep Brownell soils are on ridgetops and the upper side slopes. The shallow Heizer soils are on the steeper side slopes. The loamy Munjor soils are on flood plains. The calcareous Penden soils are on side slopes. Roxbury soils are on flood plains along drainageways.

This association is used mainly as range. Some areas are used for cultivated crops. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range. Controlling erosion and maintaining fertility are concerns in managing the cultivated areas.

6. Harney-Holdrege-Uly Association

Deep, nearly level to moderately steep, well drained soils

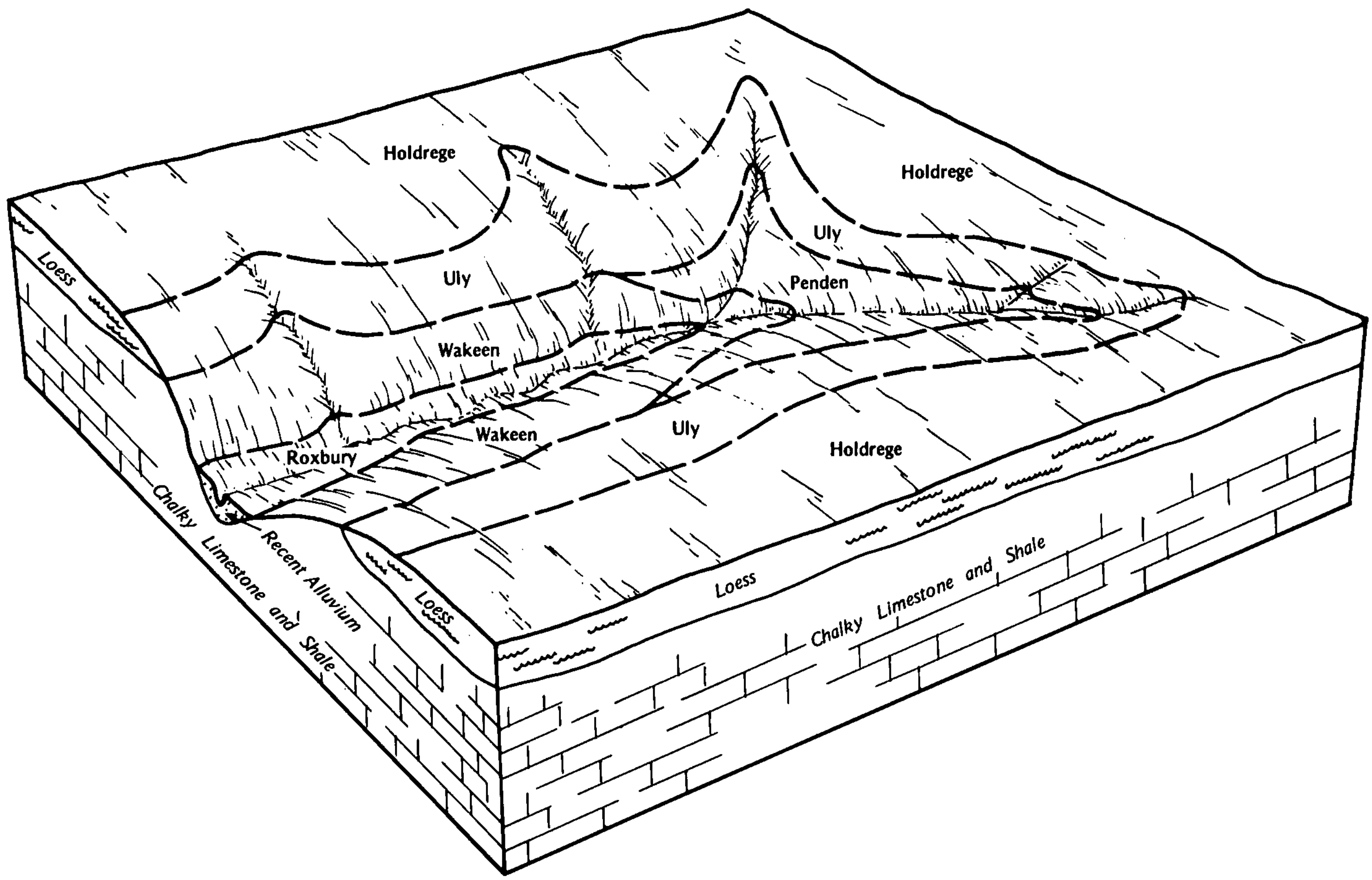


Figure 5.—Pattern of soils and parent material in the Holdrege-Uly-Wakeen association.

that have a silty clay loam or silt loam subsoil; on uplands

This association is on broad ridges and side slopes that are dissected by narrow drainageways. Slopes range from 0 to 20 percent.

This association makes up about 9 percent of the county. It is about 30 percent Harney soils, 28 percent Holdrege soils, 25 percent Uly soils, and 17 percent minor soils (fig. 6).

The nearly level Harney soils formed in loess on broad ridges. Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsurface layer also is dark grayish brown silt loam. It is about 6 inches thick. The subsoil is about 24 inches thick. The upper part is grayish brown, firm and very firm silty clay loam; the next part is light brownish gray, firm silty clay loam; and the lower part is pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The nearly level and gently sloping Holdrege soils formed in loess on broad ridges. Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is grayish brown, friable silty clay loam; the next part is pale brown, firm silty clay loam; and the lower part is pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The moderately sloping to moderately steep Uly soils formed in loess on side slopes along drainageways. Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 10 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The minor soils in this association are the deep Hobbs and Roxbury soils on flood plains along drainageways.

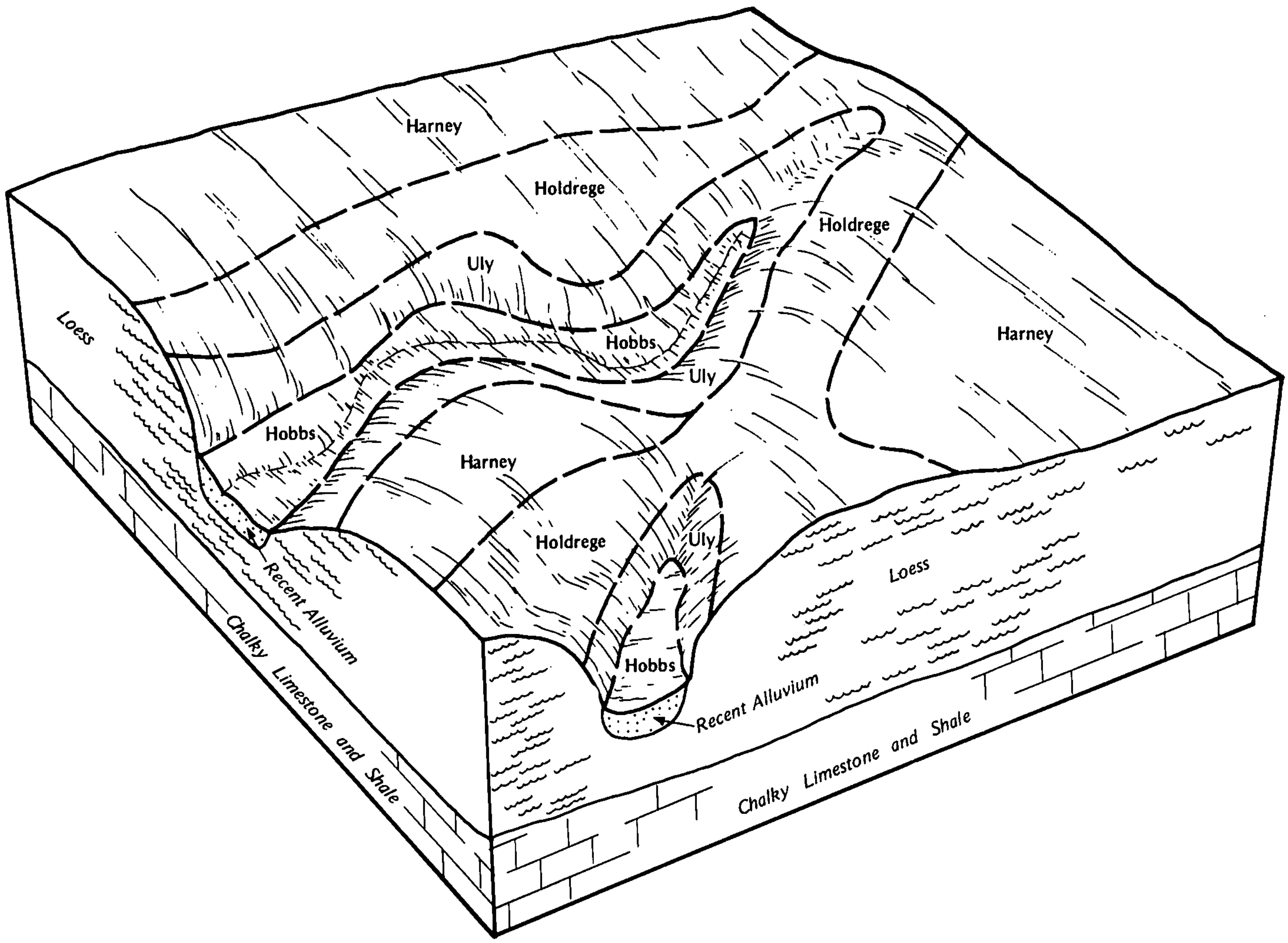


Figure 6.—Pattern of soils and parent material in the Harney-Holdrege-Uly association.

This association is used mainly for cultivated crops. A few moderately sloping to moderately steep areas are used as range. Wheat, grain sorghum, and alfalfa are the main crops. Controlling erosion, conserving moisture, and maintaining fertility and tilth are the main concerns in managing the cultivated areas. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Uly silt loam, 3 to 6 percent slopes, is a phase in the Uly series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Wakeen-Nibson complex, 7 to 20 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, quarries, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Am—Anselmo fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridgetops and stream terraces. Individual areas are irregular in shape and range from 40 to more than 200 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 12 inches thick. The subsoil is pale brown, very friable fine sandy loam about 17 inches thick. The substratum to a depth of about 60 inches is loamy fine sand. The upper part is pale brown, and the lower part is very pale brown. In places the surface layer is calcareous.

Included with this soil in mapping are small areas of the silty Holdrege soils on the higher ridgetops. These soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Anselmo soil, and runoff is slow. Available water capacity and organic matter content are moderate. Natural fertility is medium. The surface layer is neutral. It is very friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

Most areas are used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Erosion and soil blowing are hazards if cultivated crops are grown. Terraces, grassed waterways, contour farming, wind stripcropping, conservation cropping systems, and conservation tillage help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is well suited to dwellings and septic tank absorption fields but is poorly suited to sewage lagoons. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIe, nonirrigated and irrigated, and the range site is Sandy.

An—Anselmo fine sandy loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on ridgetops and stream terraces. Individual areas are irregular in shape and range from 50 to more than 900 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 12 inches thick. The subsoil is pale brown, very friable fine sandy loam about 17 inches thick. The substratum to a depth of about 60 inches is loamy fine sand. The upper part is pale brown, and the lower part is very pale brown. In some places the soil is loam or silt loam throughout. In other places the depth to lime is less than 30 inches.

Included with this soil in mapping are small areas of the moderately deep Campus soils on the lower side slopes. These soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Anselmo soil, and runoff is medium. Available water capacity and organic matter content are moderate. Natural fertility is medium. The surface layer is neutral. It is very friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

Most areas are used as range. Some small areas are used for cultivated crops. This soil is moderately well suited to wheat, alfalfa, and grain sorghum. Erosion and soil blowing are hazards if cultivated crops are grown. Terraces, grassed waterways, contour farming, wind stripcropping, conservation cropping systems, and conservation tillage help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including little bluestem, sand bluestem, prairie sandreed, and blue grama. Currently, the dominant vegetation is little bluestem and sand bluestem. If the range is used throughout the growing season, these species decrease in abundance and are replaced by sideoats grama, blue grama, and sand dropseed. If overuse continues for many years, the site is dominated by sand dropseed, sand paspalum, annual grasses, unpalatable forbs, and woody species.

Erosion and soil blowing are hazards if the range is overused. They can be controlled by maintaining an adequate plant cover. Reseeding may be necessary if the more desirable mid and tall grasses have been removed. Grazing management that includes a proper stocking rate, a scheduled deferment of grazing during the growing season, and a uniform distribution of grazing helps to keep the range productive.

This soil is well suited to dwellings and septic tank absorption fields. It is poorly suited to sewage lagoons because of seepage and slope. Seepage can be controlled by sealing the floor and walls of the lagoon. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, nonirrigated and irrigated, and the range site is Sandy.

Ar—Armo loam, 2 to 6 percent slopes. This deep, moderately sloping, well drained soil is on foot slopes and the lower side slopes. Individual areas are long and narrow and range from 20 to 300 acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 6 inches thick. The subsurface layer is grayish brown, calcareous loam about 10 inches thick. The subsoil is pale brown, friable, calcareous loam about 24 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous loam. The surface soil is pale brown in areas where it has been mixed with the upper part of the subsoil by plowing. In places the surface soil and subsoil are fine sandy loam.

Included with this soil in mapping are small areas of the moderately deep Wakeen soils on the upper side slopes. These soils make up about 10 percent of the map unit.

Permeability is moderate in the Armo soil, and runoff is medium. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

Most areas are used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, and alfalfa. Erosion and soil blowing are hazards if cultivated crops are grown. Terraces, grassed waterways, contour farming, wind stripcropping, conservation tillage, and conservation cropping systems help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because of seepage and slope. Seepage can be controlled by sealing the floor and walls of the lagoon. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, nonirrigated, and the range site is Limy Upland.

Bo—Bogue silty clay, 6 to 12 percent slopes. This moderately deep, moderately well drained, strongly sloping soil is on uplands. Individual areas are irregular in shape and range from 30 to more than 100 acres in size.

Typically, the surface layer is gray, very firm silty clay about 7 inches thick. The subsoil is gray and light gray, extremely firm clay about 22 inches thick. The substratum is light gray, mottled clay about 10 inches thick. Light gray and dark gray shale bedrock is at a depth of about 39 inches.

Included with this soil in mapping are small areas of the silty Uly soils on the slightly higher upland slopes. These soils make up about 10 percent of the map unit.

Permeability is very slow in the Bogue soil, and runoff is rapid. Available water capacity, natural fertility, and organic matter content are low. Root development is restricted below a depth of about 39 inches. The surface layer is mildly alkaline and very firm, and tilth is poor. The shrink-swell potential is high in the subsoil.

Most areas are used as range. Because of a severe hazard of erosion, this soil generally is unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including big bluestem, little bluestem, and sideoats grama. If the range is used throughout the growing season, big bluestem and little bluestem decrease in abundance and are replaced by western wheatgrass and blue grama and finally by buffalograss.

Erosion is a hazard if the range is overused. The formation of livestock trails commonly results in gullying. During extended wet periods, the soil on the steeper slopes tends to shear and slide down the slope. Once these areas are denuded, restoring productivity is difficult. Reseeding is difficult because of the high content of clay and the erosive slopes. Maintaining an adequate plant cover helps to control runoff and soil loss and increases the supply of moisture available for plant growth. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

This soil is poorly suited to dwellings. The high shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling.

Because of the depth to bedrock and the very slow permeability, this soil generally is unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the depth to bedrock and the slope. The deeper, less sloping areas on foot slopes are the best sites for lagoons.

The land capability classification is VIe, nonirrigated, and the range site is Blue Shale.

Br—Bridgeport silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on terraces along the major streams. Individual areas are irregular in shape and range from 50 to 500 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is pale brown, calcareous, friable silt loam about 10 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In some places the subsoil is stratified with sand below a depth of 40 inches. In other places the dark surface layer is thicker.

Permeability is moderate, and runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa (fig. 7). Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is well suited to dwellings and septic tank absorption fields and is moderately well suited to sewage lagoons. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIc, nonirrigated, and I, irrigated, and the range site is Loamy Terrace.

Figure 7.—No-till grain sorghum in an area of Bridgeport silt loam, 0 to 2 percent slopes.

Bw—Brownell-Heizer gravelly loams, 7 to 20 percent slopes. These strongly sloping and moderately steep soils are on uplands dissected by deeply entrenched drainageways. The shallow, somewhat excessively drained Heizer soil is on side slopes. The moderately deep, well drained Brownell soil is on ridgetops and the upper side slopes. Individual areas are irregular in shape and range from 30 to several hundred acres in size. They are about 50 percent Brownell soil and 35 percent Heizer soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Brownell soil has a surface layer of dark grayish brown gravelly loam about 8 inches thick. The subsoil is pale brown, friable channery loam about 8 inches thick. The substratum is very pale brown very channery loam about 12 inches thick. Chalky limestone bedrock is at a depth of about 28 inches (fig. 8).

Typically, the Heizer soil has a surface layer of dark grayish brown gravelly loam about 6 inches thick. The subsurface layer is grayish brown very channery loam about 3 inches thick. The subsoil is very pale brown very channery loam about 4 inches thick. Chalky limestone bedrock is at a depth of about 13 inches.

Included with these soils in mapping are small areas of the deep Armo, Roxbury, and Uly soils and small areas where limestone crops out. Armo soils are on foot slopes. Roxbury soils are on flood plains along drainageways. The silty Uly soils are on ridgetops and the upper side slopes. The limestone outcrops are in areas between the upper side slopes and the ridgetops. Included areas make up about 15 percent of the map unit.

Permeability is moderate in the Brownell and Heizer soils, and runoff is rapid. Available water capacity, natural fertility, and organic matter content are low. Root penetration is restricted at a depth of about 13 inches in the Heizer soil and 28 inches in the Brownell soil. The surface layer of the Heizer soil is mildly alkaline, and that of the Brownell soil is moderately alkaline. The shrink-swell potential is low in both soils.

Most areas are used as range. Because of the shallow depth to bedrock in the Heizer soil and a severe hazard of erosion on both soils, this map unit generally is unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including big bluestem, little bluestem, and sideoats grama. If the range is used throughout the growing season, big bluestem decreases in abundance and little bluestem and sideoats grama increase. If overuse continues for many years, little bluestem and sideoats grama decrease in abundance and are replaced by blue grama, hairy grama, buffalograss, and perennial and annual forbs.

Erosion is a hazard if the range is overused. Root penetration is restricted in the shallow Heizer soil. Maintaining an adequate plant cover helps to control runoff and soil loss and increases the supply of moisture available for plant growth. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

These soils generally are unsuited to building site development because of the slope and the limited depth to bedrock.

The land capability classification is VIIs, nonirrigated. The Brownell soil is in the Limy Upland range site, and the Heizer soil is in the Shallow Limy range site.

Cc—Campus-Canlon loams, 5 to 20 percent slopes. These moderately sloping to moderately steep soils are on uplands that generally are dissected by deeply entrenched drainageways. The moderately deep, well drained Campus soil is on narrow ridgetops. The shallow, somewhat excessively drained Canlon soil is on side slopes. Individual areas are irregular in shape and range from 40 to several hundred acres in size. They are about 55 percent Campus soil and 35 percent Canlon soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Campus soil has a surface layer of grayish brown, calcareous loam about 9 inches thick. The subsoil is light brownish gray, friable, calcareous loam about 9 inches thick. The substratum is white, calcareous loam about 15 inches thick. White caliche bedrock is at a depth of about 33 inches. In some places the depth to bedrock is less than 20 inches, and in others it is more than 40 inches.

Typically, the Canlon soil has a surface layer of grayish brown, calcareous loam about 6 inches thick. The next layer is light brownish gray, calcareous gravelly loam about 5 inches thick. The substratum is white, calcareous gravelly loam about 2 inches thick. White caliche bedrock is at a depth of about 13 inches.

Included with these soils in mapping are small areas of the silty Uly soils on side slopes. Also included are areas where caliche crops out. Included areas make up about 10 percent of the map unit.

Permeability is moderate in the Campus and Canlon soils, and runoff is rapid. Available water capacity is low. Organic matter content is moderate in the Campus soil and low in the Canlon soil. Natural fertility is medium in the Campus soil and low in the Canlon soil. Root penetration is restricted by the caliche at a depth of about 29 inches in the Campus soil and 13 inches in the Canlon soil. The surface layer of the Campus soil is mildly alkaline, and that of the Canlon soil is moderately alkaline. The shrink-swell potential is low in both soils.

Most areas are used as range. Because of a severe hazard of erosion on both soils and the shallow depth to bedrock in the Canlon soil, this map unit is generally unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including big bluestem, little bluestem,

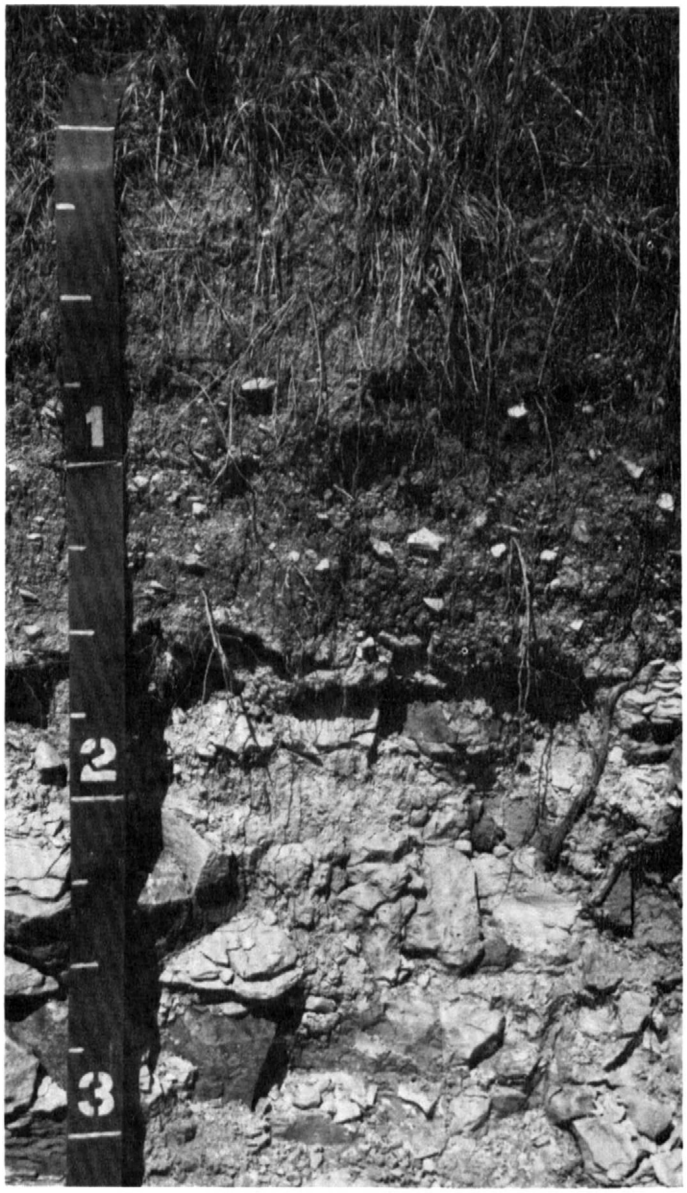


Figure 8.—Profile of Brownell gravelly loam, which is underlain by chalky limestone bedrock. Depth is marked in feet.

and sideoats grama. If the range is used throughout the growing season, big bluestem decreases in abundance and little bluestem and sideoats grama increase. If overuse continues for many years, little bluestem and sideoats grama decrease in abundance and are replaced by blue grama, hairy grama, buffalograss, and perennial and annual forbs.

Erosion and soil blowing are hazards if the range is overused. Root penetration is restricted in the shallow Canlon soil. Maintaining an adequate plant cover helps to control runoff and soil loss and increases the supply of moisture available for plant growth. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

The Canlon soil generally is unsuited to building site development because of the slope and the shallow depth to bedrock. The Campus soil is poorly suited to dwellings, septic tank absorption fields, and sewage lagoons. The depth to bedrock is the main limitation. The slope also is a limitation on sites for sewage lagoons. The deeper included soils are better suited to building site development.

The land capability classification is VIe, nonirrigated. The Campus soil is in the Limy Upland range site, and the Canlon soil is in the Shallow Limy range site.

De—Detroit silty clay loam. This deep, nearly level, moderately well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 15 to 300 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 5 inches thick. The subsurface layer also is dark grayish brown silty clay loam. It is about 15 inches thick. The subsoil is about 25 inches thick. It is dark grayish brown. The upper part is very firm silty clay, and the lower part is firm silty clay loam. The substratum to a depth of about 60 inches is grayish brown, calcareous silt loam. In places the depth to lime is less than 22 inches.

Included with this soil in mapping are small areas of the well drained Hord soils. These soils are in positions on the landscape similar to those of the Detroit soil. They make up about 15 percent of the map unit.

Permeability is slow in the Detroit soil. Runoff also is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is slightly acid. It is friable and can be easily tilled. The shrink-swell potential is high in the subsoil.

Nearly all areas are used for cultivated crops. This soil is well suited to dryland wheat and grain sorghum. The clayey subsoil, however, restricts the downward movement of water and air and the penetration of plant roots and slowly releases water to plants. Returning crop residue to the soil and adding other organic material improve fertility and tilth and increase the rate of water infiltration. Minimizing tillage helps to prevent excessive compaction.

This soil is well suited to irrigation. Corn and grain sorghum are suitable irrigated crops. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrows reduce the runoff rate and improve water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

Because of the flooding and the high shrink-swell potential, this soil is poorly suited to dwellings. Dikes, levees, and similar structures lessen the flooding hazard. Onsite inspection and knowledge of the flooding history of prospective sites are needed when building sites are selected. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling.

This soil is well suited to sewage lagoons. It is poorly suited to septic tank absorption fields. The slow permeability restricts the absorption of effluent. It can be overcome by enlarging the field or by installing the lateral lines below the subsoil.

The land capability classification is IIc, nonirrigated, and I, irrigated, and the range site is Loamy Terrace.

Ha—Harney silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on broad upland ridgetops. Individual areas are irregular in shape and range from 30 to more than 1,000 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsurface layer also is dark grayish brown silt loam (fig. 9). It is about 6 inches thick. The subsoil is about 24 inches thick. The upper part is grayish brown, firm and very firm silty clay loam; the next part is light brownish gray, firm silty clay loam; and the lower part is pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. The surface soil is silty clay loam in areas where it has been mixed with the upper part of the subsoil by plowing. In places the subsoil is less clayey.

Included with this soil in mapping are somewhat poorly drained, clayey soils in small depressional areas. These soils make up about 2 percent of the map unit.

Permeability is moderately slow in the Harney soil, and runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is slightly acid. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Inadequate rainfall is a problem if cultivated crops are grown. Summer fallowing and leaving crop residue on the surface conserve moisture. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

Because of the shrink-swell potential, this soil is only moderately well suited to dwellings. Properly designing and reinforcing foundations and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderately slow permeability restricts the absorption of effluent. It can be overcome by enlarging the absorption field or by installing the lateral lines below the subsoil. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor of the lagoon.

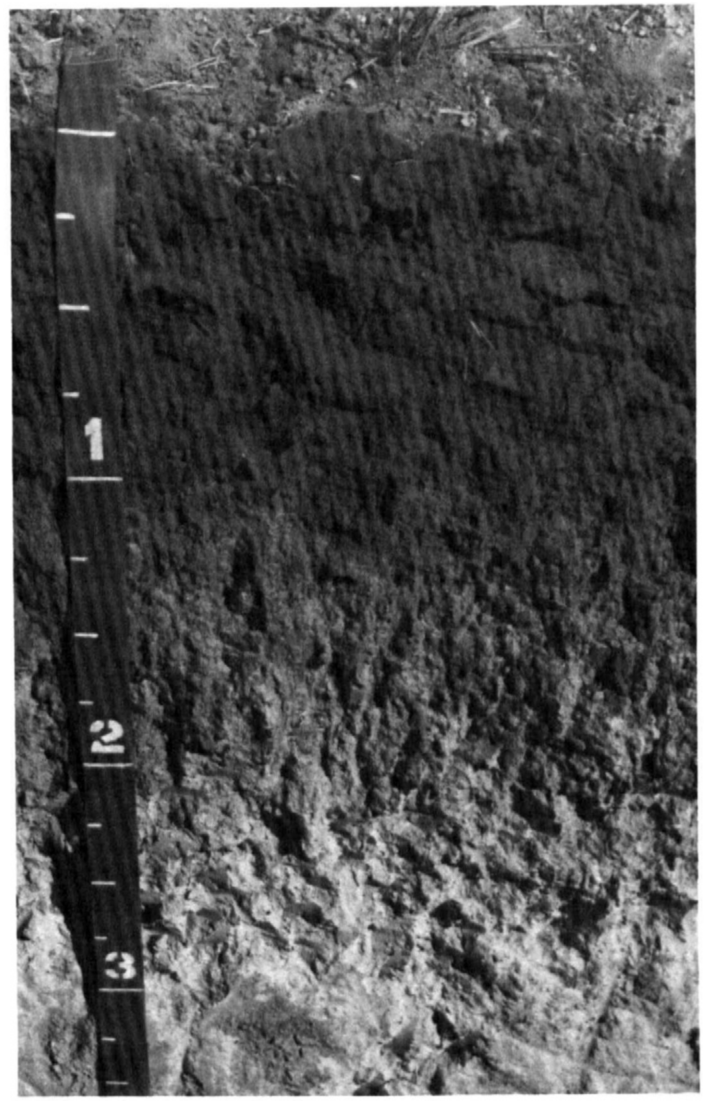


Figure 9.—Profile of Harney silt loam, 0 to 1 percent slopes. The surface soil is dark. Depth is marked in feet.

The land capability classification is IIc, nonirrigated, and I, irrigated. The range site is Loamy Upland.

Hb—Hobbs silt loam, channeled. This deep, nearly level, well drained soil is on flood plains along small creeks and intermittent drainageways. It is frequently flooded. Individual areas are narrow and elongated. They are 300 to 900 feet wide, 1,000 to 15,000 feet long, and 20 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 9 inches thick. The next layer is stratified grayish brown and light brownish gray silt loam about 17 inches thick. Below this is dark grayish brown silt loam about 9 inches thick. The substratum to a depth of about 60 inches is light brownish gray silt loam. In places the surface layer is calcareous.

Included with this soil in mapping are small areas of Roxbury and Hord soils, which make up about 10 percent of the map unit. The calcareous Roxbury soils are lower on the flood plains than the Hobbs soil. The noncalcareous Hord soils are on small terraces above the flood plains. Also included are stream channels, small cutbank areas, and small areas of Uly soils. These included areas make up about 5 percent of the map unit.

Permeability is moderate in the Hobbs soil, and runoff is slow. Available water capacity is high. Organic matter content is moderate, and natural fertility is medium. The surface layer is neutral. The shrink-swell potential is low.

Most areas are used as range. Because of the flooding hazard, this soil generally is unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall grasses, including big bluestem, little bluestem, switchgrass, and western wheatgrass. If the range is used throughout the growing season, these grasses decrease in abundance and are replaced by western wheatgrass, blue grama, buffalograss, and other less desirable species. The soil is well suited to trees because it receives extra soil moisture. The major species are black walnut, cottonwood, American elm, red elm, green ash, and hackberry.

Recurrent flooding, channeling, and deposition are hazards. Areas near watering facilities and shade trees where animals congregate are commonly overused and are in poor condition. Fencing and properly locating salting and watering facilities help to distribute grazing more evenly. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

This soil is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is Vw, nonirrigated, and the range site is Loamy Lowland.

Hg—Hobbs silt loam, occasionally flooded. This deep, nearly level, well drained soil is on narrow flood plains and alluvial fans. Individual areas are long and narrow and range from 40 to several hundred acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 9 inches thick. The next layer is stratified grayish brown and light brownish gray silt loam about 17 inches thick. Below this is dark grayish brown silt loam about 9 inches thick. The substratum to a depth of about 60 inches is light brownish gray silt loam. In places the surface layer is calcareous.

Included with this soil in mapping are scattered small areas of the calcareous Roxbury soils. These soils make up about 10 percent of the map unit.

Permeability is moderate in the Hobbs soil, and runoff is slow. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is low.

Most areas are used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, and alfalfa. In some years crop yields are reduced by the flooding, but in other years they may be increased by the extra moisture. Overcoming the flooding hazard is difficult without major flood-control measures. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

Areas along streams are wooded. Edge areas where the woodland adjoins cropland or range provide good habitat for several kinds of wildlife. Planting one or two new species of trees or shrubs in the wooded areas can increase the number of wildlife species.

This soil is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, nonirrigated and irrigated, and the range site is Loamy Lowland.

Hn—Holdrege silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil generally is on broad upland ridgetops. In a few areas, however, it is on high terraces bordering streams. Individual areas are irregular in shape and range from 50 to 700 acres in size.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is grayish brown, friable silty clay loam; the next part is pale brown, firm silty clay loam; and the lower part is pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In places the upper part of the subsoil is more clayey.

Included with this soil in mapping are clayey soils in small depressions or swales. These soils make up about 2 percent of the map unit.

Permeability is moderate in the Holdrege soil, and runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

Most areas are used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Inadequate rainfall is a problem if cultivated crops are grown. Summer fallowing and leaving crop residue on the surface conserve moisture. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is moderately well suited to dwellings. The moderate shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling.

This soil is well suited to septic tank absorption fields and moderately well suited to sewage lagoons. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIc, nonirrigated, and I, irrigated. The range site is Loamy Upland.

Ho—Holdrege silt loam, 1 to 3 percent slopes. This gently sloping, well drained soil is on broad upland ridgetops dissected by drainageways. Individual areas are irregular in shape and range from 50 to 700 acres in size.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is grayish brown, friable silty clay loam; the next part is pale brown, firm silty clay loam; and the lower part is pale brown, friable silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places the upper part of the subsoil is more clayey. The surface soil is pale brown silty clay loam in areas where it has been mixed with the subsoil by plowing.

Included with this soil in mapping are clayey soils in small depressions. These soils make up about 5 percent of the map unit.

Permeability is moderate in the Holdrege soil, and runoff is medium. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

Most areas are used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and conservation tillage help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is moderately well suited to dwellings. The moderate shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling.

This soil is well suited to septic tank absorption fields. It is only moderately well suited to sewage lagoons because of seepage and slope. Seepage can be controlled by sealing the floor and walls of the lagoon. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIe, nonirrigated and irrigated, and the range site is Loamy Upland.

Hw—Hord silt loam. This deep, nearly level, well drained soil is on stream terraces parallel to and higher than the flood plains along the larger streams. The soil is subject to flooding. Individual areas range from 50 to more than 700 acres in size.

Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silt loam about 12 inches thick. The subsoil is grayish brown, friable silt loam about 16 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In places the surface layer is calcareous.

Included with this soil in mapping are small areas of the calcareous Armo soils on foot slopes. Also included are terrace escarpments and short, steep slopes between the stream terraces and the flood plains. Included areas make up about 15 percent of the map unit.

Permeability is moderate in the Hord soil, and runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is low in the subsoil.

Most areas are used for cultivated crops. This soil is well suited to dryland wheat, grain sorghum, and alfalfa. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is well suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops (fig. 10). Returning crop residue to the soil and adding other organic material help to maintain the organic matter content, tilth, and fertility. Efficient water management is needed. Land leveling or contour furrows reduce the runoff rate and improve water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

Because of the flooding, this soil is poorly suited to dwellings and is only moderately well suited to septic tank absorption fields. Dikes, levees, and similar structures lessen the flooding hazard. Onsite inspection and knowledge of the flooding history of prospective sites are needed when sites for buildings and septic tank absorption fields are selected. The soil is moderately well suited to sewage lagoons. Seepage is a limitation. It can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIc, nonirrigated, and I, irrigated, and the range site is Loamy Terrace.

Figure 10.—Irrigated corn in an area of Hord silt loam.

In—Inavale loamy fine sand, occasionally flooded. This deep, undulating, somewhat excessively drained soil is on terraces and flood plains that generally are parallel to stream valleys. Most areas range from 40 to 200 acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 6 inches thick. The next layer is light brownish gray, loose loamy fine sand about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown sand. In some places strata of fine sandy loam or loam are in the substratum. In other places the surface layer is fine sand or sand.

Included with this soil in mapping are small areas of McCook and Munjor soils. The silty McCook soils are slightly higher on the landscape than the Inavale soil or are in similar positions. Munjor soils are in the more nearly level areas or in landscape positions similar to those of the Inavale soil. They are less sandy than the Inavale soil. Included soils make up about 15 percent of the map unit.

Permeability is rapid in the Inavale soil, and runoff is slow. Available water capacity, natural fertility, and organic matter content are low. The surface layer is mildly alkaline. It is loose and can be easily tilled. The shrink-swell potential is low.

Most areas are used as range. Some are used for cultivated crops. Because of the hazard of soil blowing, this soil is poorly suited to cultivated crops. Conservation cropping systems, conservation tillage, and wind stripcropping help to prevent excessive soil loss.

This soil is better suited to range than to cultivated crops. The climax vegetation is dominated by mid and tall prairie grasses, including sand bluestem, prairie sandreed, and little bluestem. Currently, the dominant vegetation is sand bluestem and little bluestem. If the range is used throughout the growing season, these grasses decrease in abundance and are replaced by western wheatgrass, windmillgrass, and blue grama and finally by kochia, ragweed, Russian-thistle, and other undesirable annuals.

If the range is overused, soil blowing is a hazard. It can be controlled by maintaining an adequate plant cover. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

Areas along streams are wooded. Edge areas where the woodland adjoins cropland or range provide good habitat for several kinds of wildlife. Planting one or two new species of trees or shrubs can increase the number of wildlife species.

This soil is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IVe, nonirrigated, and IIIe, irrigated. The range site is Sandy Lowland.

Ip—Inavale loamy fine sand, hummocky. This deep, moderately sloping, somewhat excessively drained soil is on terraces along the major stream valleys in the county. It is subject to rare flooding in all areas, except for some of the higher ones. Individual areas are irregular in shape and range from 10 to 40 acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 6 inches thick. The next layer is light brownish gray, loose loamy fine sand about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown sand. In some places the surface layer is fine sand or sand. In other places the substratum has strata of fine sandy loam or loam.

Permeability is rapid, and runoff is slow. Natural fertility, organic matter content, and available water capacity are low. The surface layer is mildly alkaline. The shrink-swell potential is low.

Most areas are used as range. Because of the hazard of soil blowing, this soil generally is unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including sand bluestem, prairie sandreed, and little bluestem. Currently, the dominant vegetation is sand bluestem and little bluestem. If the range is used throughout the growing season, these grasses decrease in abundance and are replaced by western wheatgrass, windmillgrass, and blue grama and finally by kochia, annual ragweed, Russian-thistle, and other undesirable annuals.

If the range is overused, soil blowing is a hazard. It can be controlled by maintaining an adequate plant cover. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures. Many areas are good sources of the sand used as building material.

The land capability classification is VIe, nonirrigated, and IVe, irrigated. The range site is Sands.

Mk—McCook silt loam. This deep, nearly level, well drained soil is on terraces along the major streams. It is subject to rare flooding. Individual areas range from 30 to 600 acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 5 inches thick. The subsurface layer also is grayish brown, calcareous silt loam. It is about 6 inches thick. The next layer is light brownish gray, very friable, calcareous silt loam about 12 inches thick. The substratum to a depth of about 60 inches is light gray, calcareous silt loam. In some places the surface soil is more than 20 inches thick. In other places the subsoil is silty clay loam. In some areas faint mottles are below a depth of 30 inches. In other areas the surface layer is noncalcareous.

Included with this soil in mapping are small areas of Munjor soils on flood plains along the stream channels. These soils are more sandy than the McCook soil. They make up about 15 percent of the map unit.

Permeability is moderate in the McCook soil, and runoff is slow. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is low.

Most areas are used for cultivated crops. This soil is well suited to dryland wheat, grain sorghum, and alfalfa. Soil blowing is a hazard if cultivated crops are grown. Conservation cropping systems, conservation tillage, and wind stripcropping help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is well suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops. Returning crop residue to the soil and adding other organic material help to maintain the organic matter content, tilth, and fertility. Efficient water management is needed. Land leveling and contour furrows reduce the runoff rate and improve water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

Because of the flooding, this soil is poorly suited to dwellings and is only moderately well suited to septic tank absorption fields. Dikes, levees, and similar structures lessen the flooding hazard. Onsite inspection and knowledge of the flooding history of prospective sites are needed when sites for buildings and septic tank absorption fields are selected. The soil is moderately well suited to sewage lagoons. Seepage is a limitation. It can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIc, nonirrigated, and I, irrigated, and the range site is Loamy Terrace.

Mu—Munjor sandy loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along the major streams in the county. Individual areas are long and narrow and range from 20 to several hundred acres in size.

Typically, the surface layer is grayish brown sandy loam about 6 inches thick. The next layer is light brownish gray, very friable sandy loam about 6 inches thick. The upper part of the substratum is light brownish gray fine sandy loam. The lower part to a depth of about 60 inches is pale brown sand. In places the soil has a dark surface layer more than 10 inches thick.

Included with this soil in mapping are small areas of Inavale, McCook, and Roxbury soils. McCook and Roxbury soils are slightly higher on the landscape than the Munjor soil. Also, they are less sandy. The sandy Inavale soils are on stream terraces. Also included are long, narrow areas in entrenched stream channels that are not arable and that generally are bordered by deciduous trees. Included areas make up about 5 percent of the map unit.

Permeability is moderately rapid in the Munjor soil, and available water capacity is moderate. Runoff is slow. Natural fertility and organic matter content are low. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is low.

Most areas are used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, and alfalfa. Flooding and soil blowing are hazards if cultivated crops are grown. In years of above average rainfall, flooding delays planting and harvesting and causes some damage to crops. Overcoming the flooding hazard is difficult without major flood-control measures. Conservation tillage, wind stripcropping, and conservation cropping systems help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

Areas along the streams are wooded. Edge areas where the woodland adjoins cropland or range provide good habitat for several kinds of wildlife. Planting one or two new species of shrubs or trees can increase the number of wildlife species.

This soil is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIIw, nonirrigated, and the range site is Sandy Lowland.

Pe—Penden loam, 2 to 6 percent slopes. This deep, moderately sloping, well drained soil is on upland ridges and side slopes. Individual areas are generally long and narrow and range from 20 to 200 acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 9 inches thick (fig. 11). The subsoil is friable, calcareous loam about 24 inches thick. The upper part is pale brown, and the lower part is very pale brown. The substratum to a depth of about 60 inches is very pale brown, calcareous loam. In some places the subsoil is thinner. In other places the soil is leached of carbonates to a depth of as much as 20 inches.

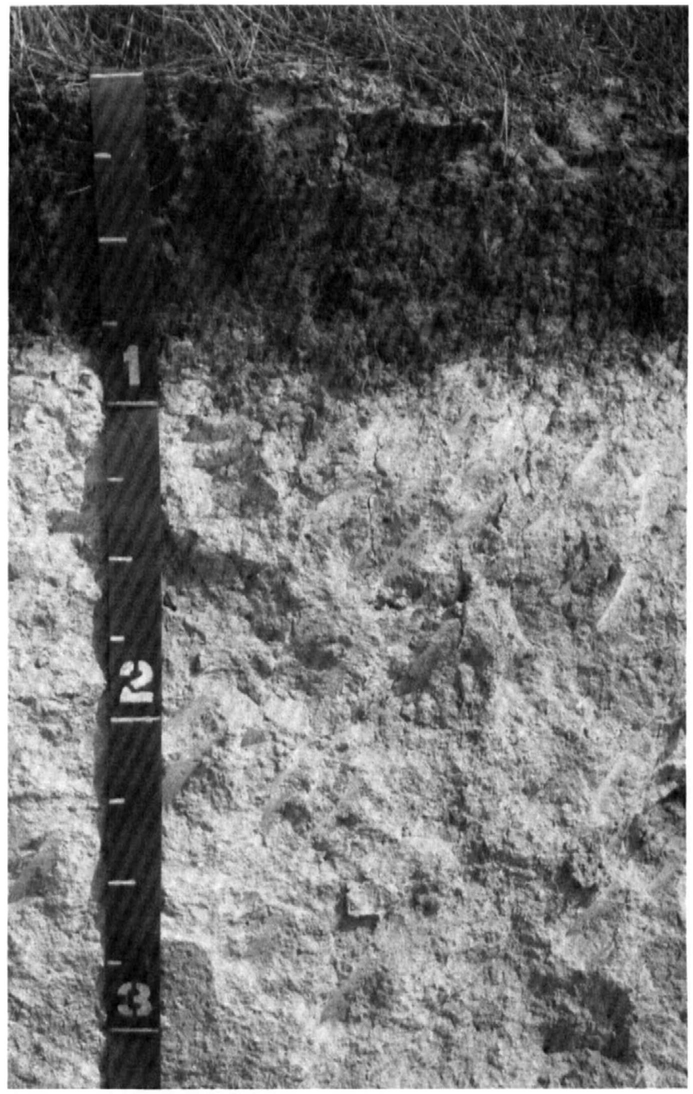


Figure 11.—Profile of Penden loam, 2 to 6 percent slopes. This soil is dark to a depth of 7 to 20 inches. Depth is marked in feet.

Included with this soil in mapping are small areas of Anselmo and Uly soils. Anselmo soils are lower on the landscape than the Penden soil. Also, they are more sandy. Uly soils are on ridgetops and the upper slopes. They are more silty than the Penden soil. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Penden soil, and runoff is medium. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is moderate in the subsoil.

Most areas are used for cultivated crops. This soil is moderately well suited to wheat, grain sorghum, and alfalfa. Erosion and soil blowing are hazards if cultivated crops are grown. Terraces, grassed waterways, contour farming, wind stripcropping, conservation cropping systems, and conservation tillage help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. Slope and seepage are limitations on sites for sewage lagoons. Some land shaping commonly is needed to overcome the slope. Seepage can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIIe, nonirrigated, and the range site is Limy Upland.

Pt—Pits, quarries. This map unit consists of areas from which soil and some underlying sandstone have been removed (fig. 12). The underlying material has been quarried for use in road construction and for ornamental purposes. It also has been used as riprap on dams. Individual areas are irregular in shape and range from 40 to 120 acres in size.

A typical quarry is a pit surrounded by a vertical wall 8 to 30 feet high. Scattered small piles of sandstone and mounds of overburden are throughout the mined areas and around the outer edges.

This map unit is unsuited to cultivation and to most other uses. The surface generally is bare. The overburden supports scattered trees, shrubs, and clumps of grass. It can be leveled or smoothed and then planted to such grasses as big bluestem, little bluestem, sideoats grama, indiangrass, and switchgrass. Cottonwood is a common invader where the excavations have been abandoned. If vegetation has been reestablished, the pits are well suited to wildlife habitat. Planting woody species improves the diversity of the vegetation. The more diverse vegetation commonly attracts additional wildlife species.

This map unit has not been assigned to a land capability classification or a range site.

Ro—Roxbury silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are long and narrow and range from 40 to more than 500 acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is dark grayish brown, calcareous silt loam about 30 inches thick. The next layer is grayish brown, friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In some places the surface layer and subsoil are loam. In other places the surface layer is noncalcareous.

Included with this soil in mapping are small areas of Munjor soils on flood plains. These soils are more sandy than the Roxbury soil. They make up about 10 percent of the map unit. Also included are long, narrow areas in entrenched stream channels that are not arable. The channels generally support deciduous trees. They make up about 5 percent of the map unit.

Permeability is moderate in the Roxbury soil, and available water capacity is high. Runoff is slow. Natural fertility is high, and organic matter content is moderate. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is moderate.

Most areas are used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Soil blowing is a hazard if cultivated crops are grown. Conservation tillage, wind stripcropping, and conservation cropping systems help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is well suited to irrigation. Corn, grain sorghum, and alfalfa are suitable irrigated crops. Returning crop residue to the soil and adding other organic material help to maintain the organic matter content, tilth, and fertility. Efficient water management is needed. Land leveling and contour furrows reduce the runoff rate and improve water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

Because of the flooding, this soil is poorly suited to dwellings and is only moderately well suited to septic tank absorption fields. Dikes, levees, and similar structures lessen the flooding hazard. Onsite inspection and knowledge of the flooding history of prospective sites are needed when sites for buildings and septic tank absorption fields are selected. The soil is moderately well suited to sewage lagoons. Seepage is a limitation. It can be controlled by sealing the floor and walls of the lagoon.

The land capability classification is IIc, nonirrigated, and I, irrigated, and the range site is Loamy Terrace.

Rp—Roxbury silt loam, channeled. This deep, nearly level, well drained soil is on flood plains along small

Figure 12.—An area of Pits, quarries. Opaline sandstone is in the foreground.

creeks and intermittent drainageways. It is occasionally flooded. Individual areas are narrow and elongated. They are 300 to 900 feet wide, 1,000 to 15,000 feet long, and 20 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is dark grayish brown, calcareous silt loam about 30 inches thick. The next layer is grayish brown, friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In places the substratum is stratified with limestone pebbles, generally below a depth of 40 inches.

Included with this soil in mapping are small areas of the noncalcareous Hobbs and Hord soils, which make up about 10 percent of the map unit. Hobbs soils are lower on the flood plains than the Roxbury soil. Hord soils are on small terraces. Also included are stream channels, small cutbank areas, and small areas of Uly soils. These areas make up about 5 percent of the map unit.

Permeability is moderate in the Roxbury soil, and runoff is slow. Available water capacity and natural fertility are high. Organic matter content is moderate. The surface layer is mildly alkaline. The shrink-swell potential is moderate.

Most areas are used as range. Because of the hazard of flooding, this soil generally is unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall grasses, including big bluestem, little bluestem, sideoats grama, and western wheatgrass. If the range is used throughout the growing season, the taller warm-season grasses decrease in abundance and are replaced by western wheatgrass, blue grama, buffalograss, and other less desirable species.

Recurrent flooding, channeling, and deposition are hazards. Areas near watering facilities and shade trees where animals congregate are generally overused and are in poor condition. Fencing and properly locating salting and watering facilities help to distribute grazing more evenly. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

Areas along the streams are wooded. Edge areas where the woodland adjoins cropland or range provide good habitat for several kinds of wildlife. Planting one or two new species of shrubs or trees can increase the number of wildlife species.

This soil is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is Vw, nonirrigated, and the range site is Loamy Lowland.

Rs—Roxbury silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains and along upland drainageways. The stream channel dissects some areas. Individual areas are long and narrow and range from 40 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is dark grayish brown, calcareous silt loam about 30 inches thick. The next layer is grayish brown, friable, calcareous silt loam about 11 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In places the surface soil and subsoil are loam.

Included with this soil in mapping are small areas of Munjor soils. These soils are more sandy than the Roxbury soil. They are in positions on the landscape similar to those of the Roxbury soil. They make up about 10 percent of the map unit. Also included are long, narrow areas in entrenched stream channels that are not arable. The channels generally support deciduous trees. They make up about 5 percent of the map unit.

Permeability is moderate in the Roxbury soil, and runoff is slow. Natural fertility and available water capacity are high. Organic matter content is moderate. The surface layer is mildly alkaline. It is friable and can be easily tilled. The shrink-swell potential is moderate.

Most areas are used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Flooding and soil blowing are hazards if cultivated crops are grown. In some years crop yields are reduced by the flooding, but in other years they may be increased by the extra moisture. In years of above average rainfall, flooding delays planting and harvesting and causes some damage to crops. Overcoming the flooding hazard is difficult without major flood-control measures. Conservation tillage, wind stripcropping, and conservation cropping systems help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is IIw, nonirrigated and irrigated, and the range site is Loamy Terrace.

Rv—Roxbury Variant silty clay, frequently flooded. This deep, nearly level, poorly drained soil is on the flood plain adjacent to Kirwin Lake. It occurs as a long and narrow area about 800 acres in size. Most of the area formerly was covered by water from Kirwin Lake.

Typically, the surface layer is gray, calcareous, very firm silty clay about 8 inches thick. The upper part of the substratum is gray and light gray, mottled, calcareous, very firm silty clay. The lower part to a depth of about 60 inches is light gray, mottled, calcareous very fine sandy loam and fine sandy loam.

Included with this soil in mapping are small areas of the well drained Munjor soils and small areas of very poorly drained soils. Munjor soils have less clay than the Roxbury Variant soil. Also, they are higher on the landscape. The very poorly drained soils generally have a water table near the surface and are in the lower areas near Kirwin Lake. Included soils make up about 15 percent of the map unit.

Permeability is slow in the upper part of the Roxbury Variant soil and moderately rapid in the lower part. Runoff is slow. Natural fertility and available water capacity are high. Organic matter content is moderate. The surface layer is moderately alkaline. The shrink-swell potential is high. The soil has a seasonal high water table at a depth of about 1 to 2 feet in spring and summer.

Most of the acreage is used as wildlife habitat. The vegetation is cottonwood, tamarisk, willows, and smartweed. Because of the wetness and the flooding, this soil generally is unsuited to cultivated crops and to building site development. Overcoming the flooding hazard is difficult without major flood-control measures.

The land capability classification is Vw, nonirrigated. No range site is assigned.

Uc—Uly silt loam, 3 to 6 percent slopes. This deep, moderately sloping, well drained soil generally is on side slopes adjacent to drainageways. In some areas it is on the upper side slopes adjacent to steeper areas. Individual areas are long and narrow and range from 40 to 600 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 10 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places the subsoil and substratum are yellowish brown or reddish yellow. The surface layer is brown or pale brown silty clay loam in areas where it has been mixed with the subsoil by plowing.

Included with this soil in mapping are small areas of Penden and Wakeen soils on the lower side slopes. Penden soils are more sandy than the Uly soil. Wakeen soils are moderately deep. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Uly soil, and runoff is rapid. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is low.

Most areas are used for cultivated crops. This soil is moderately well suited to wheat, corn, grain sorghum, and alfalfa. Erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and conservation tillage help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because of slope and seepage. Seepage can be controlled by sealing the floor and walls of the lagoon. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, nonirrigated and irrigated, and the range site is Loamy Upland.

Ud—Uly silt loam, 6 to 10 percent slopes. This deep, strongly sloping, well drained soil is on side slopes adjacent to upland drainageways. Individual areas are long and narrow and range from 40 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 10 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In places the subsoil and substratum are light yellowish brown or reddish yellow. The surface layer is brown or pale brown silty clay loam in areas where it has been mixed with the subsoil by plowing.

Included with this soil in mapping are small areas of Penden and Wakeen soils on the lower side slopes. Penden soils are more sandy than the Uly soil. Wakeen soils are moderately deep. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Uly soil, and runoff is rapid. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is low.

Most areas are used as range. Some small areas are used for cultivation crops. This soil is poorly suited to wheat, corn, grain sorghum, and alfalfa. Erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and conservation tillage help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including big bluestem, little bluestem, and sideoats grama. If the range is used throughout the growing season, big bluestem and little bluestem decrease in abundance and sideoats grama and blue grama become the dominant vegetation. If overuse continues for many years, the site is dominated by blue grama, buffalograss, and western wheatgrass.

If the range is overused, erosion is a hazard. It can be controlled by maintaining an adequate plant cover. Management that includes a proper stocking rate, development of watering facilities, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

This soil is moderately well suited to dwellings and septic tank absorption fields and is poorly suited to sewage lagoons. The slope is the main limitation. The less sloping included soils are better sites for these uses.

The land capability classification is IVe, nonirrigated and irrigated, and the range site is Loamy Upland.

Ue—Uly silt loam, 6 to 10 percent slopes, eroded. This deep, strongly sloping, well drained soil is on side slopes adjacent to upland drainageways. In some areas erosion has removed the original surface layer. Individual areas are long and narrow and range from 40 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 10 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some places the subsoil and substratum are light yellowish brown or reddish yellow. The surface layer is pale brown silty clay loam in areas where it has been mixed with the subsoil by plowing. In a few places the surface layer is calcareous.

Included with this soil in mapping are small areas of Penden and Wakeen soils on the lower side slopes. Penden soils are more sandy than the Uly soil. Wakeen soils are moderately deep. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Uly soil, and runoff is rapid. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is neutral. It is friable and can be easily tilled. The shrink-swell potential is low.

Most areas are used for cultivated crops. This soil is poorly suited to wheat, corn, grain sorghum, and alfalfa. Erosion is a hazard if cultivated crops are grown. Rills have formed near the base of some slopes, and small gullies have formed in some areas. Terraces, grassed waterways, contour farming, and conservation tillage help to prevent excessive soil loss. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration.

This soil is moderately well suited to dwellings and septic tank absorption fields and is poorly suited to sewage lagoons. The slope is the main limitation. The less sloping included soils are better sites for these uses.

The land capability classification is IVe, nonirrigated and irrigated, and the range site is Loamy Upland.

Uh—Uly silt loam, 10 to 20 percent slopes. This deep, strongly sloping and moderately steep, well drained soil is on side slopes and ridgetops. It is in wide valleys along upland drainageways in the more dissected areas of deep loess. Individual areas are long and narrow and range from 100 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 9 inches thick. The subsoil is about 10 inches thick. It is friable. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In places the subsoil and substratum are light yellowish brown or reddish yellow.

Included with this soil in mapping are small areas of Penden and Hobbs soils. The calcareous Penden soils are on the lower side slopes. The well drained Hobbs soils are on flood plains along the upland drainageways. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Uly soil, and runoff is rapid. Available water capacity is high. Natural fertility is medium, and organic matter content is moderate. The surface layer is neutral. The shrink-swell potential is low.

Most areas are used as range. Because of a severe hazard of erosion, this soil generally is unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including big bluestem, little bluestem, and sideoats grama. If the range is used throughout the growing season, big bluestem and little bluestem decrease in abundance and sideoats grama and blue grama become the dominant vegetation. If overuse continues for many years, the site is dominated by blue grama, buffalograss, and western wheatgrass.

Erosion is a hazard if the range is overused. Maintaining an adequate plant cover helps to control runoff and soil loss and increases the supply of moisture available for plant growth. Management that includes a proper stocking rate, development of watering facilities, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

This soil is poorly suited to dwellings, septic tank absorption fields, and sewage lagoons. The slope is the main limitation. The less sloping included soils are better sites for these uses.

The land capability classification is VIe, nonirrigated, and the range site is Loamy Upland.

Up—Uly-Penden complex, 7 to 20 percent slopes. These deep, strongly sloping and moderately steep, well drained soils are on side slopes and ridgetops. The silty Uly soil is on the upper slopes and on narrow ridgetops. The loamy Penden soil is on the lower side slopes. Individual areas are irregular in shape. They are about 45 percent Uly soil and 35 percent Penden soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Uly soil has a surface layer of dark grayish brown silt loam about 9 inches thick. The subsoil is about 10 inches thick. The upper part is brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In places the subsoil and substratum are light yellowish brown or reddish yellow.

Typically, the Penden soil has a surface layer of grayish brown, calcareous loam about 9 inches thick. The subsoil is pale brown and very pale brown, calcareous loam about 24 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous loam.

Included with these soils in mapping are small areas of Anselmo, Roxbury, and Wakeen soils. Anselmo soils and the moderately deep Wakeen soils are lower on the side slopes than the Uly and Penden soils. Also, Anselmo soils are more sandy. The well drained Roxbury soils are on flood plains along upland drainageways. Included soils make up about 20 percent of the map unit.

Permeability is moderate in the Uly and Penden soils, and available water capacity is high. Runoff is rapid. Natural fertility is medium, and organic matter content is moderate. The shrink-swell potential is moderate in the Penden soil and low in the Uly soil.

Most areas are used as range. Because of a severe hazard of erosion, these soils generally are unsuited to cultivated crops. They are better suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including big bluestem, little bluestem, and sideoats grama. If the range is used throughout the growing season, big bluestem decreases in abundance and little bluestem and sideoats grama increase. If overuse continues for many years, little bluestem and sideoats grama are replaced by blue grama, buffalograss, western wheatgrass, and perennial and annual forbs.

Erosion is a hazard if the range is overused. Maintaining an adequate plant cover helps to control runoff and soil loss and increases the supply of moisture available for plant growth. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

These soils are moderately well suited to dwellings and septic tank absorption fields and are poorly suited to sewage lagoons. The slope is the main limitation. The less sloping included soils are better sites for these uses. The moderate shrink-swell potential of the Penden soil is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling. The moderate permeability of the Penden soil restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field.

The land capability classification is VIe, nonirrigated. The Uly soil is in the Loamy Upland range site, and the Penden soil is in the Limy Upland range site.

Ve—Valentine loamy fine sand, 5 to 20 percent slopes. This deep, moderately sloping to moderately steep, excessively drained soil is on hilly uplands. Individual areas are irregular in shape and range from 40 to more than 700 acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 6 inches thick. The next layer is pale brown fine sand about 5 inches thick. The substratum to a depth of about 60 inches is very pale brown fine sand.

Included with this soil in mapping are small areas of Anselmo soils on foot slopes and Munjor soils on flood plains along drainageways. Both of these soils are less sandy than the Valentine soil. They make up about 10 percent of the map unit.

Permeability is rapid in the Valentine soil, and runoff is slow. Available water capacity, natural fertility, and organic matter content are low. The surface layer is neutral. The shrink-swell potential is low.

Most areas are used as range. Because of a severe hazard of soil blowing, this soil generally is unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including sand bluestem, little bluestem, and prairie sandreed. Currently, the dominant vegetation is little bluestem, prairie sandreed, and sideoats grama. If the range is used throughout the growing season, the bluestems decrease in abundance and are replaced by western wheatgrass, windmillgrass, and blue grama and finally by kochia, annual ragweed, and other undesirable annuals.

If the range is overused, soil blowing is a hazard. It can be controlled by maintaining an adequate plant cover. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

This soil is well suited to dwellings where the slope is less than 8 percent, moderately well suited where the slope is 8 to 15 percent, and poorly suited where the slope is more than 15 percent. Less land shaping is needed if the less sloping areas are selected as building sites.

This soil is poorly suited to onsite waste disposal. The sandy substratum does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity can result in the pollution of shallow ground water. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the floor and walls of the lagoon. The slope also is a limitation affecting onsite waste disposal. If the less sloping areas are selected as sites for the disposal systems, less leveling and banking will be needed during construction.

The land capability classification is VIe, nonirrigated, and the range site is Sands.

Wk—Wakeen-Nibson complex, 7 to 20 percent slopes. These strongly sloping and moderately steep soils are on uplands dissected by deeply entrenched drainageways. The moderately deep, well drained Wakeen soil is on the less sloping ridgetops and side slopes. The shallow, somewhat excessively drained Nibson soil is on the steeper slopes near areas of rock outcrop. Individual areas are long and narrow and range from 40 to several hundred acres in size. They are about

55 percent Wakeen soil and 25 percent Nibson soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Wakeen soil has a surface layer of dark grayish brown, calcareous silt loam about 12 inches thick (fig. 13). The subsoil is friable, calcareous silt loam about 16 inches thick. The upper part is pale brown, and the lower part is very pale brown. The substratum is very pale brown, calcareous silt loam about 9 inches thick. White chalky limestone is at a depth of about 37 inches. In places the surface layer is loam.

Figure 13.—Profile of Wakeen silt loam, which has a dark, friable surface layer. Depth is marked in feet.

Typically, the Nibson soil has a surface layer of grayish brown, calcareous loam about 8 inches thick. The subsoil is very pale brown, calcareous silt loam about 6 inches thick. The substratum is very pale brown, calcareous silt loam about 4 inches thick. Chalky limestone is at a depth of about 18 inches.

Included with these soils in mapping are small areas of the deep Armo, Roxbury, and Uly soils and small areas of chalky rock outcrops. Armo soils are on foot slopes. Roxbury soils are on flood plains along drainageways. Uly soils are on the higher, less steep parts of the landscape. The chalky rock outcrops are in the steeper areas. Included areas make up about 20 percent of the map unit.

Permeability is moderate in the Wakeen and Nibson soils, and runoff is rapid. Available water capacity is moderate in the Wakeen soil and low in the Nibson soil. Natural fertility is medium in the Wakeen soil and low in the Nibson soil. Organic matter content is moderate in the Wakeen soil and low in the Nibson soil. Root development is restricted at a depth of about 37 inches in the Wakeen soil and 19 inches in the Nibson soil. The surface layer of the Wakeen soil is mildly alkaline, and that of the Nibson soil is moderately alkaline. The shrink-swell potential is moderate in the subsoil of both soils.

Most areas are used as range. Because of the shallow depth to bedrock in the Nibson soil and a severe hazard of erosion on both soils, this map unit generally is unsuited to cultivated crops. It is better suited to range. The climax vegetation is dominated by mid and tall prairie grasses, including big bluestem, little bluestem, and sideoats grama. If the range is used throughout the growing season, big bluestem decreases in abundance and little bluestem and sideoats grama increase. If overuse continues for many years, little bluestem and sideoats grama decrease in abundance and are replaced by blue grama, hairy grama, buffalograss, and perennial and annual forbs.

Erosion and soil blowing are hazards if the range is overused. They can be controlled by maintaining an adequate plant cover. Root penetration is restricted in the shallow Nibson soil. Grazing management that includes a proper stocking rate, a uniform distribution of grazing, and a scheduled deferment of grazing during the growing season helps to keep the range productive.

Because of the slope and the depth to bedrock, these soils generally are unsuited to sewage lagoons and septic tank absorption fields. They are only moderately well suited to dwellings because of the moderate shrink-swell, the depth to bedrock, and the slope. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling. Some land shaping commonly is needed to overcome the slope. The deeper included soils are better sites for dwellings.

The land capability classification is VIe, nonirrigated, and the range site is Limy Upland.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 286,000 acres in the survey area, or nearly 50 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are along the larger stream valleys and on the gently sloping divides on the upland ridges where the topography is not as dissected. The crops grown on this land, mainly wheat, grain sorghum, alfalfa, and corn, account for an estimated two-thirds of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

The map units that meet the requirements for prime farmland are:

Am Anselmo fine sandy loam, 1 to 3 percent slopes
An Anselmo fine sandy loam, 3 to 7 percent slopes
Ar Armo loam, 2 to 6 percent slopes
Br Bridgeport silt loam, 0 to 2 percent slopes
De Detroit silty clay loam
Ha Harney silt loam, 0 to 1 percent slopes
Hg Hobbs silt loam, occasionally flooded
Hn Holdrege silt loam, 0 to 1 percent slopes
Ho Holdrege silt loam, 1 to 3 percent slopes
Hw Hord silt loam
Mk McCook silt loam
Mu Munjor sandy loam, occasionally flooded
Pe Penden loam, 2 to 6 percent slopes
Ro Roxbury silt loam
Rs Roxbury silt loam, occasionally flooded
Uc Uly silt loam, 3 to 6 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to a land capability classification and a range site at the end of each map unit description and in tables 5 and 6. The interpretive groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops

Jerry B. Lee, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 264,900 acres in Phillips County, or more than 46 percent of the total acreage, is used for cultivated crops or is summer fallowed. During the period 1971 to 1981, wheat was grown on about 30 percent of the cropland, grain sorghum on 17 percent, and alfalfa on 7 percent (*5*). About 24 percent of the cropland was summer fallowed. The remaining 22 percent was used for oats, barley, corn, rye, and soybeans. The acreage used for wheat and summer fallow was higher during this period than that of the previous 10-year period. The acreage of grain sorghum and corn decreased.

Crop production can be increased on most farms by applying the latest technology. This soil survey can facilitate the application of such technology. The main concerns in managing the soils in Phillips County are controlling erosion and soil blowing, making the most efficient use of available water, and maintaining fertility and tilth.

If the surface is unprotected by a crop or crop residue, soil blowing is a hazard on McCook, Roxbury, and other soils that have a silt loam surface layer. It is particularly a hazard on the soils that have a fine sandy loam, loam, or loamy fine sand surface layer. Examples are Anselmo, Armo, Inavale, Munjor, and Penden soils. Erosion is the major hazard on about 90 percent of the cropland. Most of the erosion occurs on soils that have a slope of more than 1 or 2 percent. Examples are Anselmo, Armo, Holdrege, Penden, and Uly soils.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Secondly, erosion results in the pollution of streams by sediments, nutrients, and pesticides. Control of erosion minimizes this pollution and improves the quality of water.

Erosion-control measures provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods helps to control erosion and preserves the productive capacity of the soils.

Conservation tillage and conservation cropping systems help to control both erosion and soil blowing. Conservation tillage leaves all or part of the crop residue on the surface. An example is stubble mulching, which leaves the stubble of crops or crop residue essentially in place to provide a protective cover before and during the preparation of the seedbed and during at least part of the growth period of the succeeding crop. Drilled crops, such as small grain, are alternated with row crops in a conservation cropping system. Wind stripcropping helps to control soil blowing. When this measure is applied, crops are grown in relatively narrow strips perpendicular to the direction of the prevailing wind.

Terraces, diversions, grassed waterways, and contour farming are needed in combination with conservation tillage on soils that have a slope of more than 2 percent. They also are needed in areas where the slope is more than 1 percent and conservation tillage is not used. Terraces and diversions shorten the length of slopes, reduce the runoff rate, and help to control erosion. They are most practical on deep, well drained soils that have uniform slopes. Contour farming should generally be used in combination with terraces. It is best suited to the soils that have smooth, uniform slopes and are suitable for terracing.

Inadequate rainfall is a problem on all of the cropland in the county. The supply of water stored in the soil should be conserved or increased by summer fallowing and terracing. Summer fallowing helps to store moisture for the growth of succeeding crops. Most of the fallowed cropland in the county is in a wheat-sorghum-fallow rotation or a wheat-fallow-wheat rotation. Summer fallowing is most effective when the crop residue is managed by stubble mulching or by chemical fallowing. Stubble mulching also is effective in trapping snow. Both stubble mulching and terracing reduce the runoff rate.

Organic matter is a storehouse of available plant nutrients. It increases the rate of water intake, helps to prevent surface crusting, helps to control erosion, and promotes good tilth. Most of the soils in the county that are used for crops have a silt loam surface layer. Intensive rainfall causes the surface to crust. When dry, the crusted surface becomes nearly impervious to water. As a result, the runoff rate is increased. Regularly adding organic material and leaving crop residue on the surface help to prevent excessive surface crusting, increase the rate of water infiltration, and reduce the runoff rate and the hazard of erosion.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizer. On all soils the amount of fertilizer to be applied should be based on the results of soil tests, on the needs of the crop, on the expected level of yields, and on the experience of farmers. The Cooperative Extension Service can help to determine the kinds and amounts of fertilizer needed.

Information about the design of erosion-control practices is available in the local office of the Soil Conservation Service. The latest information about growing crops can be obtained from the Cooperative Extension Service or the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

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. The classes are 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 that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

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 very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units," in the yields table, and in the section "Interpretive Groups."

Rangeland

Loren J. Pearson, range conservationist, Soil Conservation Service, helped prepare this section.

About 271,400 acres in Phillips County, or more than 47 percent of the total acreage, is range. The range is throughout the county, generally adjacent to drainage systems and in the steeper areas that cannot be easily farmed. About 61,000 head of livestock use this range resource (*5*). Cow-calf enterprises are dominant, but some ranches are stocker enterprises. Also, several hundred head are full fed each year. The native range is well suited to these livestock programs.

The range supports essentially the same grass species as those of 100 years ago. Changes in the plant community are the result of environmental changes or cultural influences. Proper grazing management is the major means of improving the range. Grazing management can include many improved techniques that result in the most production on any given acre of grass.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for nearly all the soils, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Nearly all of the local livestock management programs rely on native range for grazing from the middle of May through late October. In the middle of August, the protein levels of the native grasses begin to drop below the daily requirements of the livestock. Protein supplements are needed during this period.

Range management can include a scheduled deferment of grazing. When this technique is applied, the range is grazed and rested at prescribed periods during the growing season. The rest periods allow the plants to regain vigor. Numerous variations of this system can be applied.

Native Woodland, Windbreaks, and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

Native woodland in Phillips County occurs as irregular tracts and narrow bands along streams and rivers and as narrow strips in upland drainageways. Generally, only the upper parts of these drainageways are wooded. In the northeastern part of the county, however, the drainageways are more heavily wooded and the woodland extends into the higher areas.

Hackberry-American elm-green ash is the dominant forest cover type. It is on bottom land in the Hord-Roxbury and Roxbury-Munjor-McCook soil associations and in upland drainageways in the other associations. It has succeeded cottonwood in most wooded areas. In some areas, however, cottonwood is still the dominant species. Also, it is established as a pioneer species in the flood pool of the Kirwin Reservoir. Hackberry, American elm, red elm, and green ash make up a majority of the stands. The major associated species include eastern cottonwood, black walnut, boxelder, peachleaf willow, black willow, honeylocust, osageorange, black locust, common chokecherry, and bur oak.

Trees in the wooded areas can be used for firewood and other wood products, but they are not in large enough concentrations to be of commercial value. Areas on bottom land that cannot be easily farmed have good potential for the trees used for wood products and are attractive woodland sites.

Trees grow on most of the farmsteads and ranch headquarters in the county. Some of the trees are windbreaks, but most are environmental or ornamental plantings. Eastern redcedar, Siberian elm, and lilac are the most common species in the windbreaks. Other commonly planted species are honeylocust, eastern cottonwood, Russian-olive, Austrian pine, ponderosa pine, boxelder, hackberry, green ash, black locust, and tamarisk.

Tree planting is a continual need because old trees pass maturity and deteriorate, because some trees are destroyed by insects, disease, or storms, and because new plantings are needed on expanding farmsteads. Windbreak renovation measures, such as tree removal and replacement or supplemental planting, help to maintain the effectiveness of the windbreak.

Field windbreaks occur as single hedgerows of osageorange and as shelterbelts consisting of 8 to 10 rows of trees and shrubs. Only a few hedgerows remain. They are in scattered areas throughout the county. They were planted as property lines and field boundaries, as living fences, and as a source of posts.

A few shelterbelts are throughout the county. Eastern redcedar, black locust, green ash, honeylocust, Siberian elm, Russian mulberry, hackberry, and ponderosa pine are the common species in these windbreaks.

In order for windbreaks and environmental plantings to fulfill their intended purpose, the soils on the site should be suited to the trees and shrubs selected for planting. Permeability, available water capacity, fertility, soil depth, and soil texture greatly affect the growth rate.

Trees and shrubs generally can be easily established in Phillips County. The survival rate may be restricted by competition from weeds and grasses and by a scarcity of water. The main management needs are proper site preparation before the trees and shrubs are planted. Supplemental watering is necessary during extended dry periods.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Kirwin Reservoir is the major outdoor recreation area in Phillips County. It provides public facilities for picnicking, camping, boating, and fishing. An educational nature trail is used by many visitors (fig. 14). Approximately 3,700 acres is open to the public for hunting. The goose season attracts hunters from both Kansas and Nebraska. Pheasant and quail hunting is good, and bow hunting for deer is popular. Logan City Lake is a recreation area for local residents. The county has several areas of scenic, geologic, and historic interest.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Figure 14.—A nature trail at the Kirwin National Wildlife Refuge.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Phillips County are pheasant, bobwhite quail, cottontail rabbit, geese, white-tailed deer, and mule deer. Prairie chickens, fox squirrels, mourning doves, and turkeys are hunted on a limited basis. Some coyotes, raccoons, and opossum are trapped in the county. A few peregrine falcons and both bald and golden eagles frequent the Kirwin National Wildlife Refuge late in fall and early in winter.

Nongame species are numerous because of the diversity of habitat types in the county. Cropland, woodland, and grassland are intermixed throughout the county. This intermixture provides the edge effect needed for a variety of wildlife species. Establishing additional fringe areas generally increases the wildlife population. A good windbreak commonly provides winter cover for several pheasants and cottontails, a covey of quail, and many songbirds.

Kirwin Reservoir, Logan City Lake, farm ponds, and a few sand pits provide good or fair fishing. The species commonly caught are bass, bluegill, channel catfish, and bullhead.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, grain sorghum, soybeans, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, sweetclover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, indiangrass, switchgrass, western wheatgrass, grama, ragweed, sunflowers, goldenrod, and native legumes.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are bur oak, cottonwood, black walnut, hackberry, elm, boxelder, green ash, willow, mulberry, and osageorange. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are American plum, Russian-olive, autumn-olive, fragrant sumac, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are eastern redcedar, pine, Rocky Mountain juniper, and spruce.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are gooseberry, dogwood, buckbrush, sumac, prairie rose, and chokeberry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, prairie cordgrass, cattails, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, mourning dove, meadowlark, field sparrow, cottontail, and coyote.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, owls, bobcat, thrushes, woodpeckers, squirrels, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, red-winged blackbirds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include mule deer, prairie chicken, meadowlark, killdeer, hawks, prairie dogs, badgers, and jack rabbits.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the local office of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Fish and Game Commission and from the Cooperative Extension Service.

Engineering

John A. Eberwein, civil engineer, Soil Conservation Service, helped prepare this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 15). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

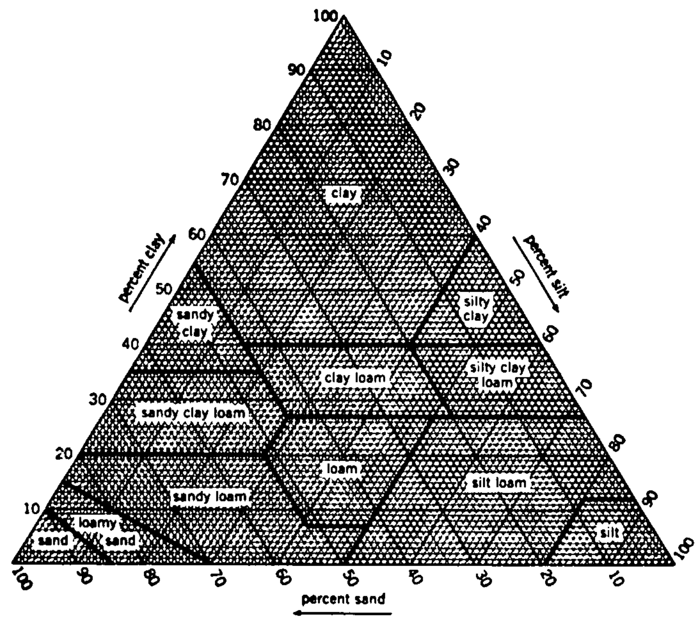


Figure 15.—Percentages of silt, clay, and sand in the basic USDA soil textural classes.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table, the kind of water table, and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16. Only saturated zones within a depth of about 6 feet are indicated. An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*7*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*6*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*7*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Anselmo Series

The Anselmo series consists of deep, well drained, moderately rapidly permeable soils on uplands and stream terraces. These soils formed in loamy eolian material. Slope ranges from 1 to 7 percent.

Anselmo soils are commonly adjacent to Holdrege, Uly, and Valentine soils. Holdrege soils are less sandy than the Anselmo soils. They are on ridgetops and the upper slopes. The silty Uly soils are in positions on the landscape similar to those of the Anselmo soils. Valentine soils are more sandy than the Anselmo soils. They are on the steeper slopes.

Typical pedon of Anselmo fine sandy loam, 3 to 7 percent slopes, 1,000 feet west and 200 feet south of the northeast corner of sec. 20, T. 5 S., R. 19 W.

A—0 to 12 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; many fine roots; neutral; gradual smooth boundary.
Bw—12 to 29 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable; many fine roots; neutral; gradual smooth boundary.
C1—29 to 44 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; weak coarse prismatic structure; slightly hard, very friable; few fine roots; neutral; gradual smooth boundary.
C2—44 to 60 inches; very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 12 to 40 inches and the depth to lime from 30 to more than 60 inches. The mollic epipedon ranges from 7 to 20 inches in thickness.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It typically is fine sandy loam, but the range includes loam, sandy loam, and loamy fine sand. The A and Bw horizons are neutral or mildly alkaline. The Bw horizon has hue of 10YR, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. It is fine sandy loam or loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is dominantly fine sandy loam or loamy fine sand. In some pedons, however, it has strata of loam, silt loam, or sand below a depth of 40 inches.

Armo Series

The Armo series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy colluvial sediments derived from chalky limestone. Slope ranges from 2 to 6 percent.

Armo soils are similar to Penden soils and are commonly adjacent to Heizer, Roxbury, and Wakeen soils. The shallow Heizer soils are on the steeper slopes. Penden soils have a calcic horizon. They are on upland ridges and side slopes. Roxbury soils have a mollic epipedon that is more than 20 inches thick. They are on flood plains and low stream terraces. The moderately deep Wakeen soils are in positions on the landscape similar to those of the Armo soils.

Typical pedon of Armo loam, 2 to 6 percent slopes, 2,550 feet north and 300 feet east of the southwest corner of sec. 31, T. 4 S., R. 17 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; strong effervescence; mildly alkaline; abrupt smooth boundary.
A—6 to 16 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; few small fragments of chalk; strong effervescence; mildly alkaline; gradual smooth boundary.
Bw—16 to 27 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; few small fragments of chalk; violent effervescence; moderately alkaline; gradual wavy boundary.
Bk—27 to 40 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, friable; few fine chalk fragments; strong effervescence; moderately alkaline; gradual smooth boundary.
C—40 to 60 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; few fine chalk fragments; few soft accumulations of lime; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. It is mildly alkaline or moderately alkaline. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It typically is loam, but the range includes silt loam and silty clay loam. The B and C horizons have hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. The B horizon is loam, clay loam, or silty clay loam. The C horizon is dominantly loam, silt loam, or clay loam. In some pedons, however, it has strata of loamy sand below a depth of 40 inches.

Bogue Series

The Bogue series consists of moderately deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in material weathered from acid shale. Slope ranges from 6 to 12 percent.

Bogue soils are commonly adjacent to Hobbs, Hord, and Uly soils. The deep Hobbs and Hord soils are on stream terraces and flood plains. The deep Uly soils are on side slopes above the Bogue soils.

Typical pedon of Bogue silty clay, 6 to 12 percent slopes, 1,200 feet south and 60 feet west of the northeast corner of sec. 19, T. 1 S., R. 19 W.

Ap—0 to 7 inches; gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) moist; moderate medium granular structure; very hard, very firm; few fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

BA—7 to 13 inches; gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; very dark gray (5Y 3/1) vertical faces of peds; weak medium blocky structure; extremely hard, extremely firm; slight effervescence; mildly alkaline; gradual wavy boundary.
Bw—13 to 29 inches; light gray (5Y 6/1) clay, gray (5Y 5/1) moist; weak coarse blocky structure; extremely hard, extremely firm; few intersecting slickensides; slight effervescence; mildly alkaline; gradual wavy boundary.
C—29 to 39 inches; light gray (5Y 7/2) clay, light olive gray (5Y 6/2) moist; common fine distinct brownish yellow (10YR 6/6) mottles; massive; some very dark gray shale fragments; extremely hard, extremely firm; mildly alkaline; gradual smooth boundary.
Cr—39 inches; light gray and dark gray, alkaline shale.

The thickness of the solum ranges from 12 to 30 inches. The depth to shale ranges from 20 to 40 inches. The depth to lime varies. Lime is in the solum. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR to 5Y, value of 4 to 7 (3 to 5 moist), and chroma of 1. It typically is silty clay, but it is clay in some pedons. The Bw horizon has hue of 2.5Y or 5Y, value of 4 to 7 (3 to 5 moist), and chroma of 1. The C horizon has hue of 2.5Y or 5Y, value of 3 to 7 (2 to 6 moist), and chroma of 1 to 3.

Bridgeport Series

The Bridgeport series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in calcareous alluvial sediments. Slope ranges from 0 to 2 percent.

Bridgeport soils are similar to Hord, McCook, and Roxbury soils and are commonly adjacent to McCook and Munjor soils. All of the similar and adjacent soils are subject to flooding. Hord and Roxbury soils have a mollic epipedon that is more than 20 inches thick. McCook soils contain less clay than the Bridgeport soils. Munjor soils contain more sand than the Bridgeport soils. They are on flood plains.

Typical pedon of Bridgeport silt loam, 0 to 2 percent slopes, 2,500 feet north and 50 feet west of the southeast corner of sec. 35, T. 4 S., R. 20 W.

A—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; few fine roots; mildly alkaline; gradual smooth boundary.
Bw—10 to 20 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary.
C—20 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; few fine pores; stratified with thin lenses of fine sandy loam and with broader bands of darker silt loam in the lower part; few threads and films of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 35 inches. The depth to lime ranges from 0 to 15 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam, but the range includes silty clay loam and fine sandy loam. This horizon ranges from neutral to moderately alkaline. The Bw and C horizons are silt loam, silty clay loam, or loam. They are mildly alkaline or moderately alkaline. The Bw horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. Contrasting sandy or clayey strata, mottles, and buried soils are below a depth of 40 inches in some pedons.

Brownell Series

The Brownell series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from thick layers of massive limestone. Slope ranges from 7 to 20 percent.

Brownell soils are commonly adjacent to Armo and Heizer soils. The deep Armo soils are in the less sloping areas. The shallow Heizer soils are on the steeper, lower side slopes.

Typical pedon of Brownell gravelly loam, in an area of Brownell-Heizer gravelly loams, 7 to 20 percent slopes, 700 feet south and 300 feet east of the northwest corner of sec. 17, T. 3 S., R. 19 W.

A—0 to 8 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine and medium roots; about 20 percent limestone fragments as much as 3 inches across; violent effervescence; moderately alkaline; gradual smooth boundary.
Bw—8 to 16 inches; pale brown (10YR 6/3) channery loam, brown (10YR 4/3) moist; moderate fine granular structure; slightly hard, friable; many fine and medium roots; porous; about 35 percent limestone fragments as much as 3 inches across; strong effervescence; moderately alkaline; gradual smooth boundary.
C—16 to 28 inches; very pale brown (10YR 8/4) very channery loam, very pale brown (10YR 7/4) moist; weak coarse subangular blocky structure; slightly hard, friable; few fine roots; porous; about 45 percent limestone fragments as much as 6 inches

across; strong effervescence; moderately alkaline; abrupt smooth boundary.
R—28 inches; very pale brown (10YR 8/3) chalky limestone.

The depth to chalky limestone bedrock ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is gravelly loam, but it is loam in some pedons. The Bw horizon has hue of 10YR, value of 3 to 6 (2 to 4 moist), and chroma of 1 to 3. It is channery or very channery loam.

Campus Series

The Campus series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy old alluvium underlain by beds of partially consolidated caliche. Slope ranges from 5 to 15 percent.

Campus soils are similar to Nibson and Penden soils and are commonly adjacent to Canlon, Penden, and Uly soils. The shallow Canlon soils are on the upper side slopes. The shallow Nibson soils are lower on the landscape than the Campus soils. The deep Penden soils are in positions on the landscape similar to those of the Campus soil. The deep, silty Uly soils are on ridgetops and the upper slopes.

Typical pedon of Campus loam, in an area of Campus-Canlon loams, 5 to 20 percent slopes, 1,500 feet south and 250 feet east of the northwest corner of sec. 16, T. 2 S., R. 20 W.

A—0 to 9 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; strong effervescence; mildly alkaline; clear smooth boundary.
Bw—9 to 18 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; moderate medium granular structure; slightly hard, friable; common fine roots; strong effervescence; mildly alkaline; gradual smooth boundary.
BCk—18 to 33 inches; white (10YR 8/2) loam, light gray (10YR 7/2) moist; massive; hard, friable; common accumulations of lime; few fine roots; violent effervescence; moderately alkaline; gradual wavy boundary.
R—33 inches; white (10YR 8/2) caliche.

The depth to caliche bedrock ranges from 20 to 40 inches. The mollic epipedon ranges from 7 to 18 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is loam, but the range includes sandy loam and silty clay loam. The A and Bw horizons are mildly alkaline or moderately alkaline. The Bw and BCk horizons are loam or clay loam. The Bw horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 to 4. The BCk horizon has hue of 10YR, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 4.

Canlon Series

The Canlon series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from limy sandstone or caliche. Slope ranges from 5 to 20 percent.

Canlon soils are similar to Heizer soils and are commonly adjacent to Campus and Penden soils. Heizer soils are lower on the landscape than the Canlon soils. Their content of coarse fragments is more than 35 percent. Campus and Penden soils have a mollic epipedon that is more than 20 inches thick. Campus soils are on narrow ridgetops. Penden soils are higher on the landscape than the Canlon soils.

Typical pedon of Canlon loam, in an area of Campus-Canlon loams, 5 to 20 percent slopes, 1,400 feet south and 190 feet east of the northwest corner of sec. 16, T. 2 S., R. 20 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine and medium roots; strong effervescence; moderately alkaline; clear smooth boundary.
AC—6 to 11 inches; light brownish gray (10YR 6/2) gravelly loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; slightly hard, friable; common fine and medium roots; about 20 percent small caliche fragments; violent effervescence; moderately alkaline; clear smooth boundary.
C—11 to 13 inches; white (10YR 8/2) gravelly loam, light gray (10YR 7/2) moist; massive; hard, friable; few fine roots; common small to large caliche fragments; violent effervescence; moderately alkaline; abrupt wavy boundary.
R—13 inches; white (10YR 8/2) caliche.

The depth to caliche bedrock ranges from 10 to 20 inches. The texture of these soils typically is loam, but the range includes silt loam, fine sandy loam, and gravelly loam. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 to 7 (3 to 6 moist), and chroma of 2 or 3. The C horizon has hue of 10YR, value of 6 to 8 (4 to 7 moist), and chroma of 2 to 4.

Detroit Series

The Detroit series consists of deep, moderately well drained, slowly permeable soils on stream terraces. These soils formed in silty alluvium or in a mixture of loess and alluvium. Slope ranges from 0 to 2 percent.

Detroit soils are similar to Harney soils and are commonly adjacent to Hord soils. Harney soils are on uplands. They have a mollic epipedon that is 10 to 20 inches thick. Hord soils have less clay than the Detroit soils. They are in positions on the landscape similar to those of the Detroit soils.

Typical pedon of Detroit silty clay loam, 2,300 feet north and 150 feet east of the southwest corner of sec. 31, T. 1 S., R. 20 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; common fine roots; slightly acid; abrupt smooth boundary.

AB—5 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, firm; few fine roots; neutral; gradual smooth boundary.

Bt1—20 to 30 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; very hard, very firm; few fine roots; neutral; clear smooth boundary.

Bt2—30 to 38 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm; neutral; clear smooth boundary.

BC—38 to 45 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate very fine subangular blocky structure; hard, firm; mildly alkaline; clear smooth boundary.

C—45 to 60 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; strong effervescence; few soft accumulations of lime; moderately alkaline.

The thickness of the solum ranges from 24 to 50 inches. The depth to lime ranges from 22 to 50 inches. The mollic epipedon ranges from 20 to 48 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It is silty clay loam or silt loam. The Bt horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2. It is silty clay loam or silty clay. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It ranges from neutral to moderately alkaline.

Harney Series

The Harney series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loess. Slope is 0 to 1 percent.

Harney soils are similar to Detroit and Holdrege soils and are commonly adjacent to Holdrege and Uly soils. Detroit soils are on stream terraces. They have a mollic epipedon that is more than 20 inches thick. Holdrege soils have less clay in the subsoil than the Harney soils. They are in the more sloping areas below the Harney soils. Uly soils are typically on the steeper slopes. They do not have an argillic horizon.

Typical pedon of Harney silt loam, 0 to 1 percent slopes, 700 feet north and 100 feet east of the southwest corner of sec. 35, T. 35 S., R. 16 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

A—5 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

Bt1—11 to 16 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; neutral; gradual smooth boundary.

Bt2—16 to 22 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; strong medium subangular blocky structure; very hard, very firm; mildly alkaline; gradual smooth boundary.

Bt3—22 to 30 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; strong medium subangular blocky structure; very hard, firm; common fine pores and root channels; mildly alkaline; gradual smooth boundary.

BC—30 to 35 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, friable; slight effervescence; moderately alkaline; gradual smooth boundary.

C—35 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 50 inches. The depth to lime is 25 to 30 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It typically is silt loam, but it is silty clay loam in some pedons. It is slightly acid or neutral. The Bt horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

Heizer Series

The Heizer series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from thick layers of massive limestone. Slope ranges from 7 to 20 percent.

Heizer soils are similar to Canlon soils and are commonly adjacent to Armo and Brownell soils. The deep Armo soils are lower on the landscape than the Heizer soils. The moderately deep Brownell and shallow Canlon soils are higher on the landscape than the Heizer soils. The content of coarse fragments in the Canlon soils is less than 35 percent.

Typical pedon of Heizer gravelly loam, in an area of Brownell-Heizer gravelly loams, 7 to 20 percent slopes, 600 feet south and 70 feet east of the northwest corner of sec. 17, T. 3 S., R. 19 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine and medium roots; about 25 percent limestone fragments as much as 3 inches across; strong effervescence; mildly alkaline; clear smooth boundary.

AC—6 to 9 inches; grayish brown (10YR 5/2) very channery loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; slightly hard, friable; common fine and medium roots; about 40 percent limestone fragments as much as 3 inches across; violent effervescence; moderately alkaline; clear smooth boundary.

C—9 to 13 inches; very pale brown (10YR 7/3) very channery loam, brown (10YR 5/3) moist; weak fine granular structure; slightly hard, friable; few fine roots; about 60 percent limestone fragments as much as 6 inches across; violent effervescence; moderately alkaline; abrupt smooth boundary.

R—13 inches; very pale brown (10YR 8/3) chalky limestone.

The depth to chalky limestone bedrock ranges from 10 to 20 inches. The thickness of the mollic epipedon is 7 to 12 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is gravelly loam, but it is loam in some pedons. The AC and C horizons are channery or very channery loam. The AC horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 1 or 2. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3.

Hobbs Series

The Hobbs series consists of deep, well drained, moderately permeable soils on flood plains and alluvial fans. These soils formed in silty, stratified alluvium. Slope ranges from 0 to 2 percent.

Hobbs soils are commonly adjacent to Uly soils. Uly soils are not stratified and have lime within a depth of 25 inches. They are not subject to flooding.

Typical pedon of Hobbs silt loam, occasionally flooded, 1,950 feet north and 300 feet west of the southeast corner of sec. 2, T. 2 S., R. 18 W.

A—0 to 9 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable; neutral; clear smooth boundary.

C—9 to 26 inches; stratified grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, very friable; neutral; gradual smooth boundary.

Ab—26 to 35 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable; neutral; gradual smooth boundary.

C'—35 to 60 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; neutral.

The upper 40 inches generally has no lime. In some pedons, however, a thin surface layer of recent deposition has a small amount of lime.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam but is fine sandy loam in some pedons. It is slightly acid to mildly alkaline. The C horizon has hue of 10YR, value of 4 to 7 (3 to 6 moist), and chroma of 1 to 3. It is dominantly silt loam or silty clay loam. In some pedons, however, it has thin strata of slightly coarser textured or finer textured material. It ranges from slightly acid to moderately alkaline.

Holdrege Series

The Holdrege series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 0 to 3 percent.

Holdrege soils are similar to Harney and Uly soils and are commonly adjacent to Anselmo, Harney, and Uly soils. Harney soils are more clayey in the subsoil than the Holdrege soils and are less sloping. They are in the higher landscape positions. Anselmo and Uly soils do not have an argillic horizon. They typically are on the steeper slopes below the Holdrege soils.

Typical pedon of Holdrege silt loam, 1 to 3 percent slopes, 1,900 feet west and 20 feet south of the northeast corner of sec. 5, T. 3 S., R. 19 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; common fine roots; neutral; abrupt smooth boundary.

A—7 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots; neutral; gradual smooth boundary.

Bt1—13 to 18 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable; few fine roots; neutral; gradual smooth boundary.

Bt2—18 to 26 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; neutral; gradual smooth boundary.

BC—26 to 31 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, friable; mildly alkaline; clear smooth boundary.

C—31 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; few soft accumulations of lime; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to lime range from 20 to 36 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It typically is silt loam, but the range includes very fine sandy loam and silty clay loam. The Bt horizon has hue of 10YR, value of 4 to 7 (3 to 5 moist), and chroma of 2 to 4. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 3 or 4. It is mildly alkaline or moderately alkaline.

Hord Series

The Hord series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty alluvium or in a mixture of loess and alluvium. Slope ranges from 0 to 2 percent.

Hord soils are similar to Bridgeport, McCook, and Roxbury soils and are commonly adjacent to Bogue, Detroit, McCook, Munjor, and Roxbury soils. The clayey Bogue soils are higher on the landscape than the Hord soils. Bridgeport soils are not subject to flooding and are slightly higher on the landscape than the Hord soils. The moderately well drained Detroit and well drained McCook soils are in positions on the landscape similar to those of the Hord soils. McCook soils have a mollic epipedon that is less than 20 inches thick. Munjor soils are more sandy than the Hord soils. They are on flood plains. Roxbury soils have lime within a depth of 15 inches. They are on flood plains and low terraces.

Typical pedon of Hord silt loam, 200 feet east and 1,820 feet south of the northwest corner of sec. 7, T. 3 S., R. 19 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, friable; common fine roots; neutral; abrupt smooth boundary.

A—8 to 20 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

Bw—20 to 29 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable; few fine roots; neutral; gradual smooth boundary.

BC—29 to 36 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

C—36 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few soft threads and films of lime; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to lime range from 30 to 48 inches. The thickness of the mollic epipedon ranges from 20 to 40 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It typically is silt loam, but the range includes loam and silty clay loam. This horizon is slightly acid or neutral. The Bw horizon has hue of 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

Inavale Series

The Inavale series consists of deep, somewhat excessively drained, rapidly permeable soils on flood plains and stream terraces. These soils formed in sandy deposits that have been reworked by the wind. Slope ranges from 1 to 7 percent.

Inavale soils are similar to Valentine soils and are commonly adjacent to McCook and Munjor soils. McCook soils are in the slightly higher positions on the stream terraces. They have a silty subsoil and a mollic epipedon. Munjor soils have a loamy subsoil. They are on flood plains. Valentine soils are in the uplands. They are not stratified.

Typical pedon of Inavale loamy fine sand, occasionally flooded, 200 feet south and 150 feet west of the northeast corner of sec. 2, T. 5 S., R. 20 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak coarse granular structure; loose; common fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

AC—6 to 14 inches; light brownish gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; single grained; loose; few fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

C—14 to 60 inches; very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) moist; single grained; loose; few fine strata of sandy loam less than 1 inch thick; few small pebbles; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 10 to 30 inches. Some pedons have no lime.

The A horizon has hue of 10YR, value of 4 to 6 (4 or 5 moist), and chroma of 2. It typically is loamy fine sand or fine sand, but the range includes fine sandy loam and loam. The A and C horizons are neutral to moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is loamy fine sand, loamy sand, fine sand, or sand. Some pedons have a few faint mottles below a depth of 40 inches.

McCook Series

The McCook series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in silty, calcareous alluvium. Slope ranges from 0 to 2 percent.

McCook soils are similar to Bridgeport, Hord, and Roxbury soils and are commonly adjacent to Bridgeport, Hord, Inavale, Munjor, and Roxbury Variant soils. Bridgeport soils contain more clay in the subsoil than the McCook soils. They are not subject to flooding. Hord and Roxbury soils are in positions on the landscape similar to those of the McCook soils. They have a mollic epipedon that is more than 20 inches thick. Also, Hord soils have no lime in the solum. Inavale, Munjor, and Roxbury Variant soils are on flood plains. Inavale and Munjor soils contain more sand than the McCook soils and do not have a mollic epipedon. Roxbury Variant soils contain more clay in the surface layer than the McCook soils.

Typical pedon of McCook silt loam, 1,000 feet east and 170 feet south of the northwest corner of sec. 11, T. 4 S., R. 18 W.

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

A—5 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable; common fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

AC—11 to 23 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—23 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; few thin strata of very fine sandy loam; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to lime ranges from 0 to 10 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It typically is silt loam, but the range includes very fine sandy loam and loam. The AC horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is silt loam, loam, or very fine sandy loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is dominantly silt loam or very fine sandy loam. In some pedons, however, it is fine sandy loam below a depth of 40 inches.

Munjor Series

The Munjor series consists of deep, well drained, moderately rapidly permeable soils on flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Munjor soils are commonly adjacent to Bridgeport, Hord, Inavale, and McCook soils. Bridgeport, Hord, and McCook soils are on stream terraces. They have a mollic epipedon. Bridgeport and McCook soils contain less sand than the Munjor soils. Hord soils contain more clay than the Munjor soils. Inavale soils are in the more sloping areas on the flood plains. They contain more sand than the Munjor soils.

Typical pedon of Munjor sandy loam, occasionally flooded, 450 feet east and 1,400 feet north of the southwest corner of sec. 31, T. 4 S., R. 19 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable;

few fine roots; mildly alkaline; clear smooth boundary.

AC—6 to 12 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; soft, very friable; few fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

C—12 to 46 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; thin strata of finer and coarser textured material; strong effervescence; moderately alkaline; gradual smooth boundary.

2C—46 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; single grained; loose; about 10 percent fine gravel; strong effervescence; moderately alkaline.

The depth to lime is less than 10 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 1 to 3. It typically is sandy loam, but the range includes fine sandy loam, loam, and loamy sand. The AC horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 1 to 3. It is sandy loam, loam, fine sandy loam, or loamy sand. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is dominantly sandy loam or fine sandy loam. In some pedons, however, it has thin strata of coarser or finer textured material. The 2C horizon has hue of 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 2 to 4. It is loamy sand or sand.

Nibson Series

The Nibson series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in silty material weathered from chalky limestone and shale. Slope ranges from 7 to 20 percent.

Nibson soils are similar to Campus and Wakeen soils and are commonly adjacent to Wakeen soils. Campus soils are more than 20 inches deep over consolidated caliche. They are higher on the landscape than the Nibson soils. The moderately deep Wakeen soils are on the less sloping ridgetops and side slopes.

Typical pedon of Nibson loam, in an area of Wakeen-Nibson complex, 7 to 20 percent slopes, 1,500 feet east and 2,260 feet south of the northwest corner of sec. 1, T. 5 S., R. 18 W.

A—0 to 8 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 small scattered limestone fragments throughout; strong effervescence; moderately alkaline; clear wavy boundary.

Bw—8 to 14 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; moderate medium granular structure; slightly hard, friable; few fine roots; violent effervescence; moderately alkaline; gradual wavy boundary.

C—14 to 18 inches; very pale brown (10YR 8/4) silt loam, very pale brown (10YR 7/4) moist; massive; slightly hard, friable; few fine roots; few small scattered limestone fragments throughout; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—18 inches; interbedded chalky limestone.

The depth to chalky limestone bedrock ranges from 10 to 20 inches. The mollic epipedon is 7 to 10 inches thick. The content of coarse fragments in the solum is less than 15 percent.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is silt loam or loam. It is mildly alkaline to strongly alkaline. The Bw and C horizons are silt loam or silty clay loam. They are moderately alkaline or strongly alkaline. The Bw horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 4.

Penden Series

The Penden series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy old alluvium. Slope ranges from 2 to 20 percent.

Penden soils are similar to Armo and Campus soils and are commonly adjacent to Campus, Holdrege, and Uly soils. Armo soils do not have a calcic horizon. They are on foot slopes and the lower side slopes. The moderately deep Campus and deep Uly soils are in positions on the landscape similar to those of the Penden soils. Uly soils have less sand in the subsoil than the Penden soils. Holdrege soils are on ridgetops. They have an argillic horizon.

Typical pedon of Penden loam, in an area of Uly-Penden complex, 7 to 20 percent slopes, 2,150 feet east and 2,200 feet north of the southwest corner of sec. 33, T. 5 S., R. 20 W.

A—0 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; strong effervescence; mildly alkaline; gradual smooth boundary.

BA—9 to 14 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium granular structure; hard, friable; many fine roots; few medium caliche fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

Bk—14 to 33 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; weak medium prismatic structure; hard, friable; many soft lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

C—33 to 60 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive; hard, friable; violent effervescence; moderately alkaline.

The mollic epipedon ranges from 7 to 20 inches in thickness. The soils are loam or clay loam throughout.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is mildly or moderately alkaline. The BA horizon has hue of 7.5YR or 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. The Bk and C horizons have hue of 10YR or 7.5YR, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 4.

Roxbury Series

The Roxbury series consists of deep, well drained, moderately permeable soils on stream terraces and flood plains. These soils formed in calcareous, silty alluvium. Slope ranges from 0 to 2 percent.

Roxbury soils are similar to Bridgeport, Hord, and McCook soils and are commonly adjacent to Armo, Hord, Munjor, Uly, and Wakeen soils. Armo, Bridgeport, McCook, and Uly soils have a mollic epipedon that is less than 20 inches thick. Armo soils are on uplands. Bridgeport and McCook soils are on the higher stream terraces. Uly soils are on the steeper upland slopes. Hord soils are on the higher stream terraces. They do not have lime in the solum. Munjor soils are on flood plains. They do not have a mollic epipedon and contain more sand in the subsoil than the Roxbury soils. The moderately deep Wakeen soils are on uplands.

Typical pedon of Roxbury silt loam, 2,400 feet north and 30 feet east of the southwest corner of sec. 28, T. 4 S., R. 19 W.

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

A—8 to 38 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots; strong effervescence; mildly alkaline; gradual smooth boundary.

AC—38 to 49 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, friable; strong effervescence; mildly alkaline; gradual smooth boundary.

C—49 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; strong effervescence; mildly alkaline.

The mollic epipedon ranges from 20 to more than 50 inches in thickness. The depth to lime ranges from 0 to 15 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It typically is silt loam, but the range includes loam and silty clay loam. The AC horizon has hue of 10YR, value of 4 to 6 (2 to 4 moist), and chroma of 1 or 2. It is silt loam or silty clay loam. The C horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is silt loam or loam. Contrasting strata of fine sandy loam or a buried soil is below a depth of 40 inches in some pedons.

Roxbury Variant

The Roxbury Variant consists of deep, poorly drained soils in lakebeds on flood plains that formerly were inundated by water. These soils formed in clayey alluvium over loamy material. Permeability is slow in the upper part of the profile and moderately rapid in the lower part. Slope ranges from 0 to 2 percent.

Roxbury Variant soils are commonly adjacent to McCook soils. McCook soils are on the higher stream terraces. They are silty throughout.

Typical pedon of Roxbury Variant silty clay, frequently flooded, 1,650 feet east and 1,620 feet south of the northwest corner of sec. 35, T. 4 S., R. 17 W.

A—0 to 8 inches; gray (5Y 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure breaking to moderate medium granular; very hard, very firm; few fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

C—8 to 21 inches; stratified gray (5Y 5/1) and light gray (5YR 6/1) silty clay, very dark gray (10YR 3/1) and dark gray (10YR 4/1) moist; common medium distinct olive yellow (2.5Y 6/8) stains and mottles on faces of peds; moderate medium blocky structure; very hard, very firm; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

2C1—21 to 33 inches; light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; common fine distinct brownish yellow (10YR 6/6) mottles; massive; slightly hard, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

2C2—33 to 60 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; few fine faint brownish yellow (10YR 6/6) mottles; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The depth to lime ranges from 0 to 10 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. In areas where the dry value is 5 or less, this horizon is less than 10 inches thick. The A and C horizons typically are silty clay but in some pedons are clay. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 or 6 (3 or 4 moist), and chroma of 1 or 2. It has mottles in most pedons. The 2C horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 3. It is dominantly fine sandy loam, loamy fine sand, silt loam, or very fine sandy loam. In some pedons, however, it has thin strata of sand or loamy fine sand. It typically has brownish yellow or olive yellow mottles.

Uly Series

The Uly series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 3 to 20 percent.

Uly soils are similar to Holdrege soils and are commonly adjacent to Hobbs, Holdrege, Penden, and Wakeen soils. Hobbs soils are on flood plains. They generally do not have lime within a depth of 40 inches. Holdrege soils have an argillic horizon. They are on ridgetops and the upper side slopes. Penden and Wakeen soils are on the lower side slopes. Penden soils contain more sand than the Uly soils, and Wakeen soils are moderately deep.

Typical pedon of Uly silt loam, 6 to 10 percent slopes, 1,700 feet north and 700 feet west of the southeast corner of sec. 21, T. 5 S., R. 20 W.

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

Bw—9 to 13 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable; few fine roots; neutral; clear smooth boundary.

BC—13 to 19 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium prismatic structure breaking to weak fine subangular blocky; slightly hard, friable; few fine roots; mildly alkaline; clear smooth boundary.

C—19 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure; slightly hard, friable; few threads and coatings of lime; strong effervescence; moderately alkaline.

The solum ranges from 12 to 36 inches in thickness. It is neutral or mildly alkaline. The depth to lime ranges from 8 to 25 inches. The mollic epipedon is 7 to 18 inches thick.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2. It typically is silt loam, but it is very fine sandy loam in some pedons. The Bw horizon has hue of 10YR, value of 4 to 7 (3 to 5 moist), and chroma of 2 or 3. It is silty clay loam or silt loam. The C horizon has hue of 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 2 or 3. It is silt loam or very fine sandy loam. It is mildly alkaline or moderately alkaline.

Valentine Series

The Valentine series consists of deep, excessively drained, rapidly permeable soils on uplands. These soils formed in sandy eolian material. Slope ranges from 5 to 20 percent.

Valentine soils are similar to Inavale soils and are commonly adjacent to Anselmo and Munjor soils. Anselmo and Munjor soils contain less sand in the solum than the Valentine soils. Also, Anselmo soils are higher on the landscape. Munjor soils are on flood plains. Inavale soils are on flood plains and stream terraces. They are stratified.

Typical pedon of Valentine loamy fine sand, 5 to 20 percent slopes, 400 feet north and 300 feet west of the center of sec. 20, T. 5 S., R. 20 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak medium granular structure; soft, very friable; many fine roots; neutral; clear smooth boundary.

AC—6 to 11 inches; pale brown (10YR 6/3) fine sand, brown (10YR 4/3) moist; single grained; few fine roots; neutral; clear smooth boundary.

C—11 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; neutral.

The soils are slightly acid or neutral loamy fine sand or fine sand throughout. The A horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2. The AC horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. The C horizon has hue of 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 2 to 4.

Wakeen Series

The Wakeen series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in silty material weathered from chalky limestone and shale. Slope ranges from 7 to 20 percent.

Wakeen soils are similar to Nibson soils and are commonly adjacent to Armo, Nibson, Roxbury, and Uly soils. The deep Armo soils are on foot slopes below the Wakeen soils. The shallow Nibson soils are on the lower side slopes. Roxbury soils have a mollic epipedon that is more than 20 inches thick. They are on flood plains. The deep Uly soils are on ridgetops and the upper side slopes.

Typical pedon of Wakeen silt loam, in an area of Wakeen-Nibson complex, 7 to 20 percent slopes, 500 feet east and 600 feet north of the southwest corner of sec. 14, T. 4 S., R. 20 W.

A—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots; strong effervescence; mildly alkaline; gradual smooth boundary.

Bw1—12 to 18 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate medium granular structure; slightly hard, friable; few fine roots; strong effervescence; mildly alkaline; gradual smooth boundary.

Bw2—18 to 28 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; weak medium subangular blocky structure; slightly hard, friable; few fine roots; few fine chalky limestone fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

C—28 to 37 inches; very pale brown (10YR 8/3) silt loam, very pale brown (10YR 7/3) moist; massive; hard, friable; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—37 inches; white chalky limestone.

The depth to chalky limestone bedrock ranges from 20 to 40 inches. The mollic epipedon ranges from 7 to 20 inches in thickness. The solum is silt loam or silty clay loam.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. The Bw horizon has hue of 10YR, value of 5 to 8 (3 to 6 moist), and chroma of 2 to 6. It is mildly alkaline to strongly alkaline.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the interaction among five factors of soil formation: 1) the physical and mineralogical composition of the parent material, 2) the climate under which the soil material has accumulated and has existed since accumulation, 3) the plant and animal life on and in the soil, 4) the relief, and 5) the length of time that the forces of soil formation have acted on the soil material. Each of these factors influences the formation of every soil, and each modifies the effects of the other four. The relative effects of the individual factors vary from place to place. The interactions among the factors are more complex for some soils than for others.

Parent Material

Parent material is the unconsolidated material in which soils form. It either is material weathered from rocks through freezing and thawing, abrasion, erosion, or chemical processes or is weathered material deposited by wind or water. The parent material affects texture, structure, color, natural fertility, and many other soil properties. Soils differ partly because of the various kinds of parent material. The texture of the parent material influences the rate of the downward movement of water and air and thus greatly affects soil formation. The composition of the parent material largely determines the mineralogical composition of the soil and, hence, its natural fertility. The parent material in Phillips County is loess, colluvium, recent alluvium, old alluvium, and material weathered from caliche, chalky limestone, and clayey shale.

Loess is silty, wind-deposited material, some of which has been carried hundreds of miles from its source. Peorian loess of the Wisconsin Glaciation covers most of the uplands in Phillips County. It was deposited during the Pleistocene. In most places it is pale brown, calcareous, friable, and porous. The silty Harney, Holdrege, and Uly soils formed in this material.

Armo soils formed in local colluvium derived from chalky limestone. They are extensive on side slopes below outcrops of Cretaceous chalky limestone in many parts of the county.

Alluvium is material that is transported and deposited by streams. Recent alluvial sediments are on the bottom land and stream terraces along the North Fork Solomon River, Bow Creek, and Prairie Dog Creek and to a lesser extent along some of the other streams in the county. Bridgeport, Detroit, Hobbs, Hord, McCook, Munjor, and Roxbury soils formed in this material. Old alluvial sediments weathered from the Ogallala Formation and were modified in the upper part by loess during the Pleistocene and during more recent times (*4*). They are deposited in many areas, mainly on the dissected uplands in the western part of the county. The old alluvium is limy and has medium and coarse sand grains. Campus and Penden soils formed in this material.

The bedrock that crops out in the county is dominantly chalky limestone, clayey shale, and caliche. Brownell, Heizer, and Wakeen soils formed in material weathered from chalky limestone. Bogue soils formed in material weathered from clayey shale. Canlon soils formed in material weathered from caliche or cemented sandstone.

Climate

Climate is an active factor of soil formation. It directly influences soil formation by weathering the parent material. It indirectly affects soil formation through its effect on plants and animals.

The climate of Phillips County is typical continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. Because of the wetting and drying, some of the basic nutrients, and even clay particles, have been leached from the upper horizons of some soils.

Plant and Animal Life

Plants and animals have important effects on soil formation. Plants generally influence the amount of nutrients and organic matter in the soil and the color of the surface layer. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous. Bacteria and fungi decompose the plants, thus releasing plant nutrients.

The mid and tall prairie grasses have had the greatest influence on soil formation in Phillips County. As a result of the grasses, the upper part of a typical soil in the county is dark and is high in content of organic matter. The transitional part in many places is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color.

Relief

Relief, or lay of the land, influences the formation of soils through its effects on drainage, runoff, plant cover, and soil temperature. Although climate and plants are the most active factors of soil formation, relief also is important, mainly because it controls the movement of water on the surface and into the soil.

Runoff is more rapid on the steeper upland soils than on the less sloping soils. As a result, erosion is more extensive. Penden and Canlon soils formed in old parent material, but relief has restricted their formation. Runoff is dominantly rapid on these gently sloping to moderately steep soils, and much of the soil material is removed as soon as a soil forms.

Time

The length of time that the soil material has been subject to weathering and the soil-forming process is commonly reflected in the degree of profile development. Soils that do not have distinct horizons are considered young, whereas those that have distinct horizons are considered old, or mature.

The soils in Phillips County range from immature to mature. Young soils, such as Bridgeport and Roxbury soils, are on bottom land that is subject to stream overflow. They receive new sediment with each flood. They have been in place long enough for the development of a thick, dark surface layer, but little or no clay has moved downward through the profile. In contrast, the mature Holdrege soils have very distinct horizons. Much of the clay has been translocated to the subsoil. Thousands of years were needed for horizon development in the Holdrege soils.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.
Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.
Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.
Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.
Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.
Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.
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	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.
Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.
Bottom land. The normal flood plain of a stream, subject to flooding.
Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.
Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.
Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.
Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.
Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.
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.
Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.
Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.
Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.
Coarse textured soil. Sand or loamy sand.
Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.
Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.
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.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

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.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

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 they are wet 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.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

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.

Fast intake (in tables). The rapid movement of water into the soil.

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 soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

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).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure 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
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

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.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It 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.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or 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).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

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 water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or 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 loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1941-70 at Phillipsburg, Kansas)

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	40.3	15.4	27.9	68	-14	0.45	0.07	0.56	1	5.7
February---	45.6	20.6	33.1	77	-7	.68	.07	1.33	2	6.6
March------	52.9	26.6	29.8	86	-1	1.34	.20	2.11	3	6.1
April------	67.2	40.0	53.6	91	17	2.42	1.29	2.99	5	1.7
May--------	76.8	50.4	63.6	99	29	3.65	1.34	5.74	6	.1
June-------	86.4	60.7	73.6	106	43	4.57	1.99	6.26	7	.0
July-------	92.8	66.1	79.5	108	48	3.46	1.44	5.57	5	.0
August-----	91.9	64.8	78.4	107	48	3.11	1.56	4.49	5	.0
September--	82.5	54.2	68.4	103	31	2.34	1.07	5.02	4	.0
October----	71.9	42.5	57.2	94	21	1.53	.31	2.64	3	.1
November---	54.9	28.4	41.7	76	2	.67	.06	1.65	1	2.7
December---	43.2	19.2	31.2	71	-10	.47	.06	.69	1	5.0
Year-----	67.2	40.7	54.0	109	-15	24.69	18.54	31.82	43	28.0

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 16	May 1	May 11
2 years in 10 later than--	Apr. 11	Apr. 26	May 6
5 years in 10 later than--	Apr. 2	Apr. 16	Apr. 26
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 21	Oct. 14	Oct. 1
2 years in 10 earlier than--	Oct. 25	Oct. 19	Oct. 5
5 years in 10 earlier than--	Nov. 4	Oct. 28	Oct. 15

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	199	170	150
8 years in 10	205	178	157
5 years in 10	216	195	172
2 years in 10	227	211	186
1 year in 10	234	219	193

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Am	Anselmo fine sandy loam, 1 to 3 percent slopes	1,700	0.3
An	Anselmo fine sandy loam, 3 to 7 percent slopes	1,690	0.3
Ar	Armo loam, 2 to 6 percent slopes	4,300	0.8
Bo	Bogue silty clay, 6 to 12 percent slopes	260	*
Br	Bridgeport silt loam, 0 to 2 percent slopes	4,000	0.7
Bw	Brownell-Heizer gravelly loams, 7 to 20 percent slopes	2,720	0.5
Cc	Campus-Canlon loams, 5 to 20 percent slopes	3,400	0.6
De	Detroit silty clay loam	730	0.1
Ha	Harney silt loam, 0 to 1 percent slopes	25,960	4.5
Hb	Hobbs silt loam, channeled	4,400	0.8
Hg	Hobbs silt loam, occasionally flooded	8,740	1.5
Hn	Holdrege silt loam, 0 to 1 percent slopes	7,390	1.3
Ho	Holdrege silt loam, 1 to 3 percent slopes	125,340	21.9
Hw	Hord silt loam	21,860	3.8
In	Inavale loamy fine sand, occasionally flooded	1,550	0.3
Ip	Inavale loamy fine sand, hummocky	940	0.2
Mk	McCook silt loam	9,380	1.6
Mu	Munjor sandy loam, occasionally flooded	6,140	1.1
Pe	Penden loam, 2 to 6 percent slopes	250	*
Pt	Pits, quarries	490	0.1
Ro	Roxbury silt loam	16,340	2.9
Rp	Roxbury silt loam, channeled	14,940	2.6
Rs	Roxbury silt loam, occasionally flooded	11,830	2.1
Rv	Roxbury Variant silty clay, frequently flooded	950	0.2
Uc	Uly silt loam, 3 to 6 percent slopes	19,160	3.3
Ud	Uly silt loam, 6 to 10 percent slopes	58,100	10.1
Ue	Uly silt loam, 6 to 10 percent slopes, eroded	105,410	18.4
Uh	Uly silt loam, 10 to 20 percent slopes	45,040	7.9
Up	Uly-Penden complex, 7 to 20 percent slopes	37,520	6.6
Ve	Valentine loamy fine sand, 5 to 20 percent slopes	720	0.1
Wk	Wakeen-Nibson complex, 7 to 20 percent slopes	29,326	5.1
	Water	2,000	0.3
	Total	572,576	100.0

* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability		Winter wheat		Grain sorghum		Alfalfa hay		Smooth bromegrass		Corn	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons	AUM*	AUM*	Bu	Bu
Am----------------- Anselmo	IIe	IIe	34	---	54	---	2.5	---	---	---	45	---
An----------------- Anselmo	IIIe	IIIe	32	---	51	---	2.3	---	---	---	41	---
Ar----------------- Armo	IIIe	---	32	---	45	---	---	---	4.0	---	---	---
Bo----------------- Bogue	VIe	---	---	---	---	---	---	---	---	---	---	---
Br----------------- Bridgeport	IIc	I	40	---	62	---	3.5	---	5.0	---	62	---
Bw----------------- Brownell-Heizer	VIIs	---	---	---	---	---	---	---	---	---	---	---
Cc----------------- Campus-Canlon	VIe	---	---	---	---	---	---	---	---	---	---	---
De----------------- Detroit	IIc	I	40	---	58	110	---	---	4.5	10.0	---	115
Ha----------------- Harney	IIc	I	39	---	60	120	---	6.5	4.5	9.0	---	140
Hb----------------- Hobbs	Vw	---	---	---	---	---	---	---	---	---	---	---
Hg----------------- Hobbs	IIw	IIw	36	---	62	---	4.0	---	---	---	68	---
Hn----------------- Holdrege	IIc	I	42	---	60	125	2.5	6.5	---	---	45	145
Ho----------------- Holdrege	IIe	IIe	40	---	56	---	2.3	---	---	---	40	---
Hw----------------- Hord	IIc	I	42	---	60	120	2.5	6.0	3.5	11.0	40	140
In----------------- Inavale	IVe	IIIe	28	---	34	---	1.8	---	---	---	25	---
Ip----------------- Inavale	VIe	IVe	---	---	---	---	---	---	---	---	---	---
Mk----------------- McCook	IIc	I	40	---	62	120	2.8	6.0	---	---	45	140
Mu----------------- Munjor	IIIw	---	34	---	50	---	2.0	---	4.0	---	40	---
Pe----------------- Penden	IIIe	---	28	---	40	---	---	---	3.5	---	---	---

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Winter wheat		Grain sorghum		Alfalfa hay		Smooth bromegrass		Corn	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons	AUM*	AUM*	Bu	Bu
Pt**. Pits												
Ro------ Roxbury	IIc	I	40	---	60	115	4.2	7.0	5.0	11.0	88	125
Rp------ Roxbury	Vw	---	---	---	---	---	---	---	---	---	---	---
Rs------ Roxbury	IIw	IIw	40	---	60	---	3.5	---	5.0	---	60	---
Rv------ Roxbury Variant	Vw	---	---	---	---	---	---	---	---	---	---	---
Uc------ Uly	IIIe	IIIe	32	---	46	---	1.9	---	3.5	---	30	---
Ud------ Uly	IVe	IVe	30	---	42	---	1.7	---	2.5	---	20	---
Ue------ Uly	IVe	IVe	28	---	38	---	1.7	---	2.5	---	18	---
Uh------ Uly	VIe	---	---	---	---	---	---	---	---	---	---	---
Up------ Uly-Penden	VIe	---	---	---	---	---	---	---	---	---	---	---
Ve------ Valentine	VIe	---	---	---	---	---	---	---	---	---	---	---
Wk------ Wakeen-Nibson	VIe	---	---	---	---	---	---	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
Am, An: Anselmo	Sandy	Favorable	3,500	Little bluestem	25
		Normal	3,000	Sand bluestem	15
		Unfavorable	2,000	Prairie sandreed	15
				Blue grama	10
				Switchgrass	5
				Western wheatgrass	5
Ar: Armo	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	3,000	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Western wheatgrass	5
Bo: Bogue	Blue Shale	Favorable	3,000	Big bluestem	40
		Normal	2,000	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	15
				Leadplant	10
				Indiangrass	5
Br: Bridgeport	Loamy Terrace	Favorable	5,000	Big bluestem	35
		Normal	4,000	Western wheatgrass	15
		Unfavorable	3,000	Switchgrass	10
				Little bluestem	10
				Sideoats grama	10
				Indiangrass	5
Bw*:					
Brownell	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	3,000	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	20
				Indiangrass	5
Heizer	Shallow Limy	Favorable	3,000	Little bluestem	40
		Normal	2,000	Big bluestem	25
		Unfavorable	900	Sideoats grama	10
				Switchgrass	5
Cc*:					
Campus	Limy Upland	Favorable	3,000	Little bluestem	35
		Normal	2,000	Big bluestem	15
		Unfavorable	1,000	Sideoats grama	15
				Switchgrass	5
				Blue grama	5
				Western wheatgrass	5
Canlon	Shallow Limy	Favorable	2,400	Little bluestem	35
		Normal	1,600	Big bluestem	25
		Unfavorable	900	Sideoats grama	10
				Switchgrass	5
				Hairy grama	5
				Plains muhly	5
				Blue grama	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
De------------------- Detroit	Loamy Terrace------------------	Favorable	5,000	Big bluestem------------------	40
		Normal	4,000	Little bluestem---------------	10
		Unfavorable	3,000	Western wheatgrass------------	10
				Sideoats grama----------------	10
				Switchgrass-------------------	5
				Indiangrass-------------------	5
Ha------------------- Harney	Loamy Upland------------------	Favorable	4,500	Big bluestem------------------	25
		Normal	3,500	Little bluestem---------------	15
		Unfavorable	2,000	Sideoats grama----------------	15
				Western wheatgrass------------	10
				Blue grama--------------------	5
Hb, Hg--------------- Hobbs	Loamy Lowland------------------	Favorable	6,000	Big bluestem------------------	40
		Normal	5,000	Western wheatgrass------------	10
		Unfavorable	3,500	Switchgrass-------------------	10
				Little bluestem---------------	5
				Sideoats grama----------------	5
				Sedge-------------------------	5
Hn, Ho--------------- Holdrege	Loamy Upland------------------	Favorable	4,000	Big bluestem------------------	20
		Normal	3,600	Little bluestem---------------	20
		Unfavorable	3,300	Sideoats grama----------------	10
				Blue grama--------------------	10
				Western wheatgrass------------	10
				Indiangrass-------------------	5
				Buffalograss------------------	5
				Sand dropseed-----------------	5
				Sedge-------------------------	5
Hw------------------- Hord	Loamy Terrace------------------	Favorable	5,000	Big bluestem------------------	40
		Normal	4,000	Little bluestem---------------	10
		Unfavorable	3,000	Western wheatgrass------------	10
				Sideoats grama----------------	10
				Switchgrass-------------------	5
				Blue grama--------------------	5
In------------------- Inavale	Sandy Lowland------------------	Favorable	4,000	Sand bluestem-----------------	35
		Normal	3,500	Little bluestem---------------	15
		Unfavorable	3,000	Prairie sandreed--------------	10
				Switchgrass-------------------	5
				Sedge-------------------------	5
Ip------------------- Inavale	Sands--------------------------	Favorable	3,500	Little bluestem---------------	25
		Normal	3,000	Sand bluestem-----------------	20
		Unfavorable	2,000	Prairie sandreed--------------	15
				Switchgrass-------------------	5
				Blue grama--------------------	5
				Sand dropseed-----------------	5
Mk------------------- McCook	Loamy Terrace------------------	Favorable	4,500	Big bluestem------------------	40
		Normal	4,000	Western wheatgrass------------	10
		Unfavorable	3,000	Little bluestem---------------	10
				Sideoats grama----------------	10
				Indiangrass-------------------	5
				Blue grama--------------------	5
				Sedge-------------------------	5
				Switchgrass-------------------	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Mu----------------- Munjor	Sandy Lowland	Favorable	4,500	Sand bluestem	35
		Normal	3,500	Switchgrass	15
		Unfavorable	3,000	Indiangrass	10
				Little bluestem	10
				Western wheatgrass	5
				Chickasaw plum	5
Pe Penden	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Switchgrass	5
				Indiangrass	5
				Western wheatgrass	5
				Leadplant	5
Ro Roxbury	Loamy Terrace	Favorable	5,000	Big bluestem	35
		Normal	4,000	Sideoats grama	15
		Unfavorable	3,000	Western wheatgrass	15
				Switchgrass	10
				Little bluestem	10
				Indiangrass	5
Rp Roxbury	Loamy Lowland	Favorable	6,000	Big bluestem	40
		Normal	5,000	Switchgrass	15
		Unfavorable	3,500	Indiangrass	10
				Western wheatgrass	10
				Little bluestem	5
Rs Roxbury	Loamy Terrace	Favorable	5,000	Big bluestem	40
		Normal	4,000	Western wheatgrass	10
		Unfavorable	3,500	Little bluestem	10
				Switchgrass	5
				Indiangrass	5
Uc, Ud, Ue, Uh Uly	Loamy Upland	Favorable	4,500	Big bluestem	25
		Normal	3,500	Little bluestem	15
		Unfavorable	2,000	Sideoats grama	15
				Blue grama	10
				Western wheatgrass	10
Up*:					
Uly	Loamy Upland	Favorable	3,700	Big bluestem	25
		Normal	3,200	Little bluestem	25
		Unfavorable	2,700	Sideoats grama	10
				Blue grama	10
				Western wheatgrass	10
				Sedge	5
Penden	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Switchgrass	5
				Indiangrass	5
				Western wheatgrass	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
Ve-----------------Valentine	Sands--------------------------	Favorable	3,000	Sand bluestem-----------------	25
		Normal	2,600	Little bluestem---------------	20
		Unfavorable	2,200	Prairie sandreed--------------	15
				Switchgrass-------------------	5
				Sand lovegrass----------------	5
				Blue grama--------------------	5
Wk*:					
Wakeen------------	Limy Upland-------------------	Favorable	4,000	Big bluestem------------------	35
		Normal	2,500	Little bluestem---------------	20
		Unfavorable	1,000	Sideoats grama----------------	15
				Switchgrass-------------------	5
				Blue grama--------------------	5
Nibson------------	Limy Upland-------------------	Favorable	3,000	Big bluestem------------------	40
		Normal	2,200	Little bluestem---------------	15
		Unfavorable	1,500	Sideoats grama----------------	15
				Indiangrass-------------------	5
				Blue grama--------------------	5
				Western wheatgrass------------	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Am, An: Anselmo	Lilac, American plum.	Common chokecherry	Eastern redcedar, Austrian pine, ponderosa pine, Scotch pine, honeylocust, green ash, hackberry, Russian mulberry.	Siberian elm	---
Ar: Armo	Fragrant sumac, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, bur oak, Russian-olive, Rocky Mountain juniper.	Ponderosa pine, honeylocust, green ash, Siberian elm.	---	---
Bo: Bogue	Peking cotoneaster, Amur honeysuckle, Siberian peashrub.	Eastern redcedar, hackberry, Russian-olive, green ash, Rocky Mountain juniper.	Austrian pine, honeylocust, Russian mulberry.	Siberian elm	---
Br: Bridgeport	American plum	Amur honeysuckle, lilac.	Eastern redcedar, Russian-olive, Austrian pine, green ash, ponderosa pine, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Bw*:					
Brownell.					
Heizer.					
Cc*:					
Campus	Fragrant sumac, silver buffaloberry, Tatarian honeysuckle, Siberian peashrub.	Rocky Mountain juniper, eastern redcedar, Russian-olive, bur oak.	Siberian elm, ponderosa pine, honeylocust, green ash.	---	---
Canlon.					
De: Detroit	American plum	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ha: Harney	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, Russian-olive, Austrian pine, green ash, hackberry.	Siberian elm	---
Hb, Hg: Hobbs	American plum	Amur honeysuckle, lilac, Siberian peashrub.	Eastern redcedar, Austrian pine, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Hn, Ho: Holdrege	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian-olive.	Siberian elm	---
Hw: Hord	Peking cotoneaster	Lilac, Siberian peashrub, American plum.	Eastern redcedar, ponderosa pine, blue spruce, Manchurian crabapple.	Golden willow, green ash, hackberry.	Eastern cottonwood.
In. Inavale					
Ip: Inavale	Lilac, American plum.	Common chokecherry	Eastern redcedar, Austrian pine, Scotch pine, ponderosa pine, green ash, honeylocust, hackberry, Russian mulberry.	Siberian elm	---
Mk: McCook	American plum, lilac.	Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, hackberry, green ash, Russian-olive, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
Mu: Munjor	American plum	Amur honeysuckle, lilac.	Eastern redcedar, ponderosa pine, green ash, Russian mulberry, Austrian pine, Russian-olive.	Honeylocust, hackberry.	Eastern cottonwood.
Pe: Penden	Fragrant sumac, silver buffaloberry, Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Siberian elm, honeylocust, ponderosa pine, green ash.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Pt*. Pits					
Ro. Roxbury	American plum	Amur honeysuckle, lilac.	Russian mulberry, ponderosa pine, green ash, Russian-olive, Austrian pine, eastern redcedar.	Hackberry, honeylocust.	Eastern cottonwood.
Rp, Rs. Roxbury	American plum	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Rv. Roxbury Variant					
Uc, Ud, Ue. Uly	Amur honeysuckle, lilac.	Common chokecherry, Russian mulberry.	Eastern redcedar, green ash, Russian-olive, honeylocust, Austrian pine, hackberry, bur oak.	Siberian elm	---
Uh. Uly					
Up*:					
Uly	Amur honeysuckle, lilac.	Common chokecherry, Russian mulberry.	Eastern redcedar, green ash, Russian-olive, honeylocust, Austrian pine, hackberry, bur oak.	Siberian elm	---
Penden	Fragrant sumac, silver buffaloberry, Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Siberian elm, honeylocust, ponderosa pine, green ash.	---	---
Ve. Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Wk*:					
Wakeen	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Honeylocust, Siberian elm, ponderosa pine, green ash.	---	---
Nibson.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Am------------------- Anselmo	Slight--------------	Slight--------------	Slight--------------	Slight.
An------------------- Anselmo	Slight--------------	Slight--------------	Moderate: slope.	Slight.
Ar------------------- Armo	Slight--------------	Slight--------------	Moderate: slope.	Slight.
Bo------------------- Bogue	Moderate: slope, percs slowly, too clayey.	Moderate: slope, too clayey, percs slowly.	Severe: slope.	Moderate: too clayey.
Br------------------- Bridgeport	Slight--------------	Slight--------------	Slight--------------	Slight.
Bw*:				
Brownell-------------	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Slight.
Heizer---------------	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Cc*:				
Campus---------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Canlon---------------	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock, small stones.	Slight.
De------------------- Detroit	Severe: flooding.	Slight--------------	Slight--------------	Slight.
Ha------------------- Harney	Slight--------------	Slight--------------	Slight--------------	Slight.
Hb------------------- Hobbs	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Hg------------------- Hobbs	Severe: flooding.	Slight--------------	Moderate: flooding.	Slight.
Hn------------------- Holdrege	Slight--------------	Slight--------------	Slight--------------	Slight.
Ho------------------- Holdrege	Slight--------------	Slight--------------	Moderate: slope.	Slight.
Hw------------------- Hord	Severe: flooding.	Slight--------------	Slight--------------	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
In------------------- Inavale	Severe: flooding.	Slight---------------	Slight---------------	Slight.
Ip------------------- Inavale	Severe: flooding.	Slight---------------	Severe: slope.	Slight.
Mk------------------- McCook	Severe: flooding.	Slight---------------	Slight---------------	Slight.
Mu------------------- Munjor	Severe: flooding.	Slight---------------	Moderate: flooding.	Slight.
Pe------------------- Penden	Slight---------------	Slight---------------	Moderate: slope.	Slight.
Pt*. Pits				
Ro------------------- Roxbury	Severe: flooding.	Slight---------------	Slight---------------	Slight.
Rp------------------- Roxbury	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Rs------------------- Roxbury	Severe: flooding.	Slight---------------	Moderate: flooding.	Slight.
Rv------------------- Roxbury Variant	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness, flooding.	Severe: too clayey.
Uc------------------- Uly	Slight---------------	Slight---------------	Moderate: slope.	Slight.
Ud, Ue--------------- Uly	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Uh------------------- Uly	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Up*:				
Uly-----------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Penden--------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ve------------------- Valentine	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
Wk*:				
Wakeen--------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Nibson--------------	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Am: Anselmo	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
An: Anselmo	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ar: Armo	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	---	Very poor.	Fair.
Bo: Bogue	Poor	Fair	Poor	Poor	Poor	Poor	Very poor.	Poor	Poor	Poor	Very poor.	Poor.
Br: Bridgeport	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
Bw*:												
Brownell	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
Heizer	Very poor.	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Cc*:												
Campus	Poor	Fair	Good	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Canlon	Poor	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
De: Detroit	Good	Good	Good	---	---	Good	Good	Good	Good	---	Good	Good.
Ha: Harney	Good	Good	Good	Poor	Poor	Good	Poor	Fair	Good	---	Poor	Good.
Hb: Hobbs	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Hg: Hobbs	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Hn, Ho: Holdrege	Good	Good	Fair	Good	Fair	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Fair.
Hw: Hord	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
In: Inavale	Fair	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Ip: Inavale	Poor	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Mk: McCook	Good	Good	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Mu-----------------Munjor	Fair	Fair	Good	Fair	Fair	Good	Poor	Poor	Fair	Fair	Poor	Good.
Pe-----------------Penden	Fair	Good	Fair	---	---	Poor	Very poor.	Poor	Fair	---	Very poor.	Fair.
Pt*. Pits												
Ro, Rp, Rs---------Roxbury	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Rv-----------------Roxbury Variant	Poor	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair	---
Uc, Ud, Ue---------Uly	Fair	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Good.
Uh-----------------Uly	Poor	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
Up*:												
Uly----------------	Poor	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Poor	Good	Very poor.	Fair.
Penden-------------	Poor	Fair	Fair	---	---	Poor	Very poor.	Poor	Fair	---	Very poor.	Fair.
Ve-----------------Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Wk*:												
Wakeen-------------	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Nibson-------------	Poor	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Am Anselmo	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
An Anselmo	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
Ar Armo	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.
Bo Bogue	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.
Br Bridgeport	Slight	Slight	Slight	Slight	Severe: low strength.
Bw*: Brownell	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, large stones.
Heizer	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Cc*: Campus	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, low strength, slope.
Canlon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
De Detroit	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Ha Harney	Moderate: too clayey.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Hb, Hg Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Hn, Ho Holdrege	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Hw Hord	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
In Inavale	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ip: Inavale	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Mk: McCook	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
Mu: Munjor	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Pe: Penden	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Pt*. Pits					
Ro: Roxbury	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Rp, Rs: Roxbury	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Rv: Roxbury Variant	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.
Uc: Uly	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.
Ud, Ue: Uly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Uh: Uly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Up*:					
Uly	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Penden	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Ve: Valentine	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Wk*:					
Wakeen	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Nibson	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Am, An: Anselmo	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Ar: Armo	Slight	Moderate: seepage, slope.	Slight	Slight	Fair: too clayey, thin layer.
Bo: Bogue	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Br: Bridgeport	Slight	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Bw*:					
Brownell	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock, small stones.
Heizer	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock, small stones.
Cc*:					
Campus	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Canlon	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
De: Detroit	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Ha: Harney	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Hb, Hg: Hobbs	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Hn: Holdrege	Slight	Moderate: seepage.	Slight	Slight	Good.
Ho: Holdrege	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Hw: Hord	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
In: Inavale	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: seepage, too sandy, flooding.	Severe: seepage, flooding.	Poor: too sandy, seepage.
Ip: Inavale	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Mk: McCook	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Mu: Munjor	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: thin layer.
Pe: Penden	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Pt*. Pits					
Ro: Roxbury	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Rp, Rs: Roxbury	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Rv: Roxbury Variant	Severe: flooding, wetness.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.
Uc: Uly	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Ud, Ue: Uly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Uh: Uly	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Up*:					
Uly	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Penden	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Ve: Valentine	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Wk*:					
Wakeen	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Nibson	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Am, An: Anselmo	Good	Probable	Improbable: too sandy.	Fair: thin layer.
Ar: Armo	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Bo: Bogue	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Br: Bridgeport	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Bw*:				
Brownell	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Heizer	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Cc*:				
Campus	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
Canlon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
De: Detroit	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ha: Harney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Hb, Hg: Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hn, Ho: Holdrege	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hw: Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
In, Ip: Inavale	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Mk: McCook	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Mu: Munjor	Good	Probable	Improbable: too sandy.	Good.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Pe: Penden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Pt*. Pits				
Ro, Rp, Rs: Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Rv: Roxbury Variant	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Uc: Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ud, Ue: Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Uh: Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Up*:				
Uly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Penden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Ve: Valentine	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Wk*:				
Wakeen	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, slope.
Nibson	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Am: Anselmo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Favorable	Too sandy, soil blowing.	Favorable.
An: Anselmo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope	Too sandy, soil blowing.	Favorable.
Ar: Armo	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope	Favorable	Favorable.
Bo: Bogue	Severe: slope.	Severe: hard to pack.	Deep to water	Droughty, slow intake, percs slowly.	Slope, depth to rock, percs slowly.	Slope, droughty, depth to rock.
Br: Bridgeport	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Bw*:						
Brownell	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Heizer	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Cc*:						
Campus	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Canlon	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
De: Detroit	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Ha: Harney	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Hb, Hg: Hobbs	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
Hn, Ho: Holdrege	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Hw: Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
In, Ip: Inavale	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Mk-----McCook	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Mu-----Munjor	Severe: seepage.	Severe: piping.	Deep to water	Flooding-------	Soil blowing---	Favorable.
Pe-----Penden	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Pt*. Pits						
Ro-----Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Rp, Rs-----Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Flooding-------	Erodes easily	Erodes easily.
Rv-----Roxbury Variant	Severe: seepage.	Severe: piping, wetness.	Percs slowly, flooding, frost action.	Wetness, slow intake, percs slowly.	Wetness--------	Wetness, percs slowly.
Uc-----Uly	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Ud, Ue, Uh-----Uly	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Up*:						
Uly-----	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Penden-----	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Ve-----Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty.
Wk*:						
Wakeen-----	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Nibson-----	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Am, An------------ Anselmo	0-12	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	100	100	60-100	30-65	<25	NP-7
	12-29	Fine sandy loam, loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	100	90-100	35-65	<25	NP-7
	29-60	Fine sandy loam, loamy fine sand.	SM, SM-SC	A-4, A-2	0	100	100	65-100	12-45	<25	NP-7
Ar--------------- Armo	0-16	Loam-------------	CL	A-6, A-4	0	95-100	90-100	90-100	70-95	25-40	7-18
	16-40	Loam, silty clay loam, clay loam.	CL	A-6, A-4, A-7-6	0	95-100	90-100	90-100	70-90	25-45	7-22
	40-60	Silt loam, clay loam, loam.	CL	A-6, A-4, A-7-6	0	95-100	85-100	70-100	65-80	25-45	7-22
Bo--------------- Bogue	0-7	Silty clay-------	CH	A-7	0	100	100	90-100	90-100	55-80	25-45
	7-29	Clay-------------	CH	A-7	0	100	100	90-100	90-100	55-80	30-50
	29-39	Clay-------------	CH	A-7	0	100	100	90-100	80-100	55-80	25-45
	39	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Br--------------- Bridgeport	0-10	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	65-90	20-35	4-19
	10-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6	0	100	100	90-100	65-100	25-40	8-20
Bw*:											
Brownell--------	0-8	Gravelly loam----	GC, SC, SM-SC, GM-GC	A-2-4, A-2-6, A-1	0-20	50-90	40-70	30-60	20-35	20-40	5-20
	8-28	Very channery loam, channery loam, gravelly loam.	GC, GP-GC, SC, SP-SC	A-2-4, A-2-6, A-1	5-50	20-80	10-50	10-45	8-35	20-40	5-20
	28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Heizer----------	0-6	Gravelly loam----	GC, SC, SM-SC, GM-GC	A-2-4, A-2-6, A-1	0-20	50-90	40-70	30-60	20-35	20-40	5-20
	6-13	Channery loam, very channery loam.	GC, SC, GP-GC, SP-SC	A-2-4, A-2-6, A-1	5-50	20-80	10-50	10-45	8-35	20-40	5-20
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cc*:											
Campus----------	0-9	Loam-------------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	80-100	55-90	20-40	3-20
	9-18	Loam, clay loam	CL, ML	A-6, A-4, A-7-6	0	100	100	75-95	50-80	33-45	8-20
	18-33	Loam, clay loam	CL, ML, SC, SM	A-6, A-4, A-7-6	0	90-100	70-100	65-85	40-80	33-45	8-20
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Cc*:											
Canlon	0-6	Loam	CL, CL-ML	A-4, A-6	0	90-100	75-100	65-100	50-90	20-40	4-20
	6-13	Loam, gravelly loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	75-100	55-100	50-95	35-85	20-40	4-20
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
De Detroit	0-20	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	90-100	35-50	20-30
	20-45	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-60	25-35
	45-60	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	25-45	10-25
Ha Harney	0-11	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	11-30	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-35
	30-60	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	30-45	10-20
Hb, Hg Hobbs	0-9	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	9-60	Silt loam, silty clay loam.	CL, CL-ML, MH	A-4, A-6, A-7	0	100	100	95-100	80-100	25-55	5-25
Hn, Ho Holdrege	0-13	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-40	2-18
	13-26	Silty clay loam	CL	A-7-6, A-6	0	100	100	98-100	90-100	30-50	15-35
	26-31	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	95-100	95-100	25-40	9-17
	31-60	Silt loam	CL, ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15
Hw Hord	0-20	Silt loam	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	3-18
	20-36	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	98-100	85-100	25-40	8-23
	36-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	85-100	25-40	6-21
In, Ip Inavale	0-6	Loamy fine sand	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	6-14	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	14-60	Fine sand, loamy fine sand, loamy sand, sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
Mk McCook	0-11	Silt loam	ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	11-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	55-100	<20	NP-10
Mu Munjor	0-6	Sandy loam	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	95-100	65-100	25-55	15-30	NP-7
	6-46	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4	0	100	95-100	65-100	35-65	15-30	3-10
	46-60	Loamy sand, sand	SM, SP-SM	A-2, A-3	0	95-100	95-100	55-100	5-30	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Pe--------------- Penden	0-9	Loam-------------	CL	A-4, A-6	0	100	100	85-100	65-95	25-40	7-20
	9-33	Clay loam, loam, silty clay loam.	CL	A-6, A-7-6	0	100	100	85-100	60-90	30-45	11-25
	33-60	Clay loam, loam	CL	A-6, A-7-6	0	100	100	75-100	55-75	30-45	11-25
Pt*. Pits											
Ro, Rp, Rs------- Roxbury	0-38	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	65-100	25-40	7-20
	38-49	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	80-100	30-50	8-25
	49-60	Silt loam, loam	ML, CL	A-4, A-6, A-7-6	0	100	100	95-100	65-100	30-50	7-25
Rv--------------- Roxbury Variant	0-21	Silty clay-------	CH, CL	A-7	0	100	100	95-100	90-100	45-70	30-45
	21-60	Very fine sandy loam, fine sandy loam, silt loam.	ML, CL-ML	A-4	0	100	100	80-100	50-80	<20	NP-5
Uc, Ud----------- Uly	0-9	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	9-19	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	19-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
Ue--------------- Uly	0-5	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	5-15	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	15-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
Uh--------------- Uly	0-9	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	9-19	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	19-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
Up*: Uly--------------	0-9	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	2-15
	9-19	Silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	100	95-100	25-40	3-15
	19-60	Silt loam, very fine sandy loam.	CL, ML	A-4, A-6	0	100	100	100	95-100	25-40	3-15
Penden----------	0-9	Loam-------------	CL	A-4, A-6	0	100	100	85-100	65-95	25-40	7-20
	9-33	Clay loam, loam, silty clay loam.	CL	A-6, A-7-6	0	100	100	85-100	60-90	30-45	11-25
	33-60	Clay loam, loam	CL	A-6, A-7-6	0	100	100	75-100	55-75	30-45	11-25
Ve--------------- Valentine	0-6	Loamy fine sand	SM, SP-SM, SP	A-2, A-3	0	100	100	95-100	2-35	---	NP
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Wk*:											
Wakeen----------	0-12	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	75-95	25-40	7-20
	12-37	Silty clay loam, silt loam.	CL	A-6, A-7-6	0	95-100	85-100	75-100	60-95	30-50	10-25
	37	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Nibson----------	0-8	Loam-------------	CL	A-4, A-6	0-15	85-100	80-95	65-95	60-90	25-40	8-20
	8-18	Silty clay loam, silt loam.	CL	A-6, A-7	0-15	85-95	80-95	60-90	55-90	30-45	10-25
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Am, An----------- Anselmo	0-12	10-18	1.30-1.60	0.6-6.0	0.13-0.18	5.6-7.8	<2	Low--------	0.20	5	3	1-2
	12-29	10-18	1.40-1.60	2.0-6.0	0.15-0.19	5.6-7.8	<2	Low--------	0.20			
	29-60	5-18	1.50-1.70	2.0-6.0	0.08-0.16	5.6-7.8	<2	Low--------	0.20			
Ar--------------- Armo	0-16	18-27	1.25-1.40	0.6-2.0	0.21-0.24	6.6-8.4	<2	Low--------	0.28	5	4L	1-3
	16-40	18-35	1.30-1.40	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.28			
	40-60	18-35	1.30-1.45	0.6-2.0	0.15-0.21	7.9-8.4	<2	Low--------	0.28			
Bo--------------- Bogue	0-7	50-75	1.10-1.30	<0.06	0.11-0.14	6.6-8.4	<2	High-------	0.28	3	4	---
	7-29	60-80	1.30-1.45	<0.06	0.09-0.11	6.6-8.4	<2	High-------	0.28			
	29-39	60-80	1.30-1.45	<0.06	0.09-0.11	7.4-8.4	<2	High-------	0.28			
	39	---	---	---	---	---	---	-----------	----			
Br--------------- Bridgeport	0-10	14-27	1.30-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low--------	0.32	5	6	1-4
	10-60	18-30	1.35-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43			
Bw*:												
Brownell---------	0-8	15-27	1.30-1.45	0.6-2.0	0.10-0.16	7.4-8.4	<2	Low--------	0.20	3	4L	---
	8-28	15-27	1.35-1.50	0.6-2.0	0.06-0.13	7.4-8.4	<2	Low--------	0.20			
	28	---	---	---	---	---	---	-----------	----			
Heizer-----------	0-6	15-27	1.30-1.45	0.6-2.0	0.10-0.16	7.4-8.4	<2	Low--------	0.24	2	8	---
	6-13	15-27	1.35-1.50	0.6-2.0	0.06-0.13	7.4-8.4	<2	Low--------	0.24			
	13	---	---	---	---	---	---	-----------	----			
Cc*:												
Campus-----------	0-9	15-27	1.25-1.35	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.28	4	4L	1-2
	9-18	18-35	1.30-1.40	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low--------	0.28			
	18-33	18-35	1.40-1.60	0.6-2.0	0.15-0.19	7.9-8.4	<2	Low--------	0.28			
	33	---	---	---	---	---	---	-----------	----			
Canlon-----------	0-6	12-27	1.30-1.45	0.6-2.0	0.15-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	---
	6-13	8-27	1.35-1.50	0.6-2.0	0.15-0.22	7.4-8.4	<2	Low--------	0.32			
	13	---	---	---	---	---	---	-----------	----			
De--------------- Detroit	0-20	28-35	1.25-1.40	0.2-0.6	0.21-0.23	6.1-7.3	<2	Moderate	0.37	5	7	2-4
	20-45	35-45	1.35-1.50	0.06-0.2	0.12-0.18	6.6-7.8	<2	High-------	0.37			
	45-60	18-35	1.30-1.50	0.2-0.6	0.18-0.22	6.6-8.4	<2	Moderate	0.37			
Ha--------------- Harney	0-11	22-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-7.8	<2	Low--------	0.32	5	6	2-4
	11-30	35-42	1.35-1.50	0.2-0.6	0.12-0.19	6.1-8.4	<2	Moderate	0.43			
	30-60	24-35	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Hb, Hg----------- Hobbs	0-9	15-27	1.20-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low--------	0.32	5	6	2-4
	9-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.32			
Hn, Ho----------- Holdrege	0-13	15-25	1.40-1.60	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	0.32	5	6	1-3
	13-26	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.43			
	26-31	18-30	1.30-1.50	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
	31-60	15-20	1.40-1.60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.43			
Hw--------------- Hord	0-20	17-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low--------	0.32	5	6	2-4
	20-36	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.1-7.8	<2	Low--------	0.32			
	36-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
In, Ip----------- Inavale	0-6	7-18	1.50-1.60	6.0-20	0.10-0.12	6.1-7.8	<2	Low-------	0.17	5	2	.5-1
	6-14	3-10	1.50-1.60	6.0-20	0.06-0.11	6.6-8.4	<2	Low-------	0.17			
	14-60	3-10	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low-------	0.17			
Mk--------------- McCook	0-11	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-------	0.32	5	4L	2-4
	11-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-------	0.43			
Mu--------------- Munjor	0-6	7-15	1.30-1.40	2.0-6.0	0.14-0.20	7.4-8.4	<2	Low-------	0.24	5	3	.5-1
	6-46	7-15	1.30-1.40	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-------	0.24			
	46-60	1-5	1.40-1.50	6.0-20	0.06-0.09	7.4-8.4	<2	Low-------	0.24			
Pe--------------- Penden	0-9	20-27	1.30-1.45	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low-------	0.28	5	4L	1-4
	9-33	24-35	1.35-1.50	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.37			
	33-60	24-35	1.30-1.50	0.6-2.0	0.14-0.19	7.9-8.4	<2	Moderate	0.37			
Pt*. Pits												
Ro--------------- Roxbury	0-38	18-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-------	0.32	5	4L	2-4
	38-49	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
	49-60	18-27	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Rp, Rs----------- Roxbury	0-38	18-27	1.30-1.45	0.6-2.0	0.22-0.24	6.6-8.4	<2	Low-------	0.32	5	4L	2-4
	38-49	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
	49-60	18-27	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Rv--------------- Roxbury Variant	0-21	40-55	1.35-1.45	0.06-0.2	0.11-0.15	7.4-8.4	<2	High------	0.28	5	4	2-4
	21-60	10-20	1.40-1.60	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low-------	0.28			
Uc, Ud----------- Uly	0-9	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	6	1-3
	9-19	20-30	1.20-1.30	0.6-2.0	0.18-0.22	6.6-8.4	<2	Low-------	0.43			
	19-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
Ue--------------- Uly	0-5	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	6	1-3
	5-15	20-30	1.20-1.30	0.6-2.0	0.18-0.22	6.6-8.4	<2	Low-------	0.43			
	15-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
Uh--------------- Uly	0-9	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	6	1-3
	9-19	20-30	1.20-1.30	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
	19-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
Up*:												
Uly-------------	0-9	17-27	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-------	0.32	5	6	1-3
	9-19	20-30	1.20-1.30	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
	19-60	18-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low-------	0.43			
Penden----------	0-9	20-27	1.30-1.45	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low-------	0.28	5	4L	1-4
	9-33	24-35	1.35-1.50	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.37			
	33-60	24-35	1.30-1.50	0.6-2.0	0.14-0.19	7.9-8.4	<2	Moderate	0.37			
Ve--------------- Valentine	0-6	2-10	1.70-1.90	6.0-20	0.10-0.12	5.6-7.3	<2	Low-------	0.17	5	2	.5-1
	6-60	0-8	1.70-1.90	6.0-20	0.05-0.11	5.6-7.3	<2	Low-------	0.15			
Wk*:												
Wakeen----------	0-12	18-27	1.30-1.45	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-------	0.32	4	4L	1-3
	12-37	18-35	1.35-1.50	0.6-2.0	0.18-0.22	7.4-9.0	<2	Moderate	0.43			
	37	---	---	---	---	---	---	----------	----			
Nibson----------	0-8	15-27	1.25-1.35	0.6-2.0	0.20-0.24	7.4-9.0	<2	Low-------	0.32	2	4L	---
	8-18	18-35	1.30-1.40	0.6-2.0	0.18-0.22	7.9-9.0	<2	Moderate	0.32			
	18	---	---	---	---	---	---	----------	----			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Am, An: Anselmo	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ar: Armo	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Bo: Bogue	D	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Moderate.
Br: Bridgeport	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Bw*:												
Brownell	B	None	---	---	>6.0	---	---	20-40	Hard	Low	Low	Low.
Heizer	D	None	---	---	>6.0	---	---	10-20	Hard	Moderate	Low	Low.
Cc*:												
Campus	B	None	---	---	>6.0	---	---	20-40	Hard	Low	Low	Low.
Canlon	D	None	---	---	>6.0	---	---	10-20	Hard	Low	Low	Low.
De: Detroit	C	Rare	---	---	>6.0	---	---	>60	---	Low	High	Low.
Ha: Harney	B	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Hb: Hobbs	B	Frequent	Brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Hg: Hobbs	B	Occasional	Brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low	Low.
Hn, Ho: Holdrege	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Hw: Hord	B	Rare	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
In: Inavale	A	Occasional	Very brief	Jan-Jul	>6.0	---	---	>60	---	Low	Moderate	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Ip---------------- Inavale	A	Rare---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Mk---------------- McCook	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Mu---------------- Munjor	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Pe---------------- Penden	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Pt*. Pits												
Ro---------------- Roxbury	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Rp---------------- Roxbury	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Rs---------------- Roxbury	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Rv---------------- Roxbury Variant	C	Frequent----	Very long	Apr-Sep	1.0-2.0	Apparent	Apr-Sep	>60	---	High------	High------	Low.
Uc, Ud, Ue, Uh---- Uly	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Up*:												
Uly--------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Penden-----------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Ve---------------- Valentine	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Wk*:												
Wakeen-----------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.
Nibson-----------	D	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	Low-------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

(LL means liquid limit; PI, plasticity index; MD, maximum dry density; and OM, optimum moisture)

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							LL	PI	Moisture density	
			Percentage passing sieve--				Percentage smaller than--					MD	OM
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
										Pct		Lb/ft3	Pct
Anselmo fine sandy loam: (S82KS-147-003)													
A----- 0 to 10	A-2	SC	100	100	77	23	13	9	7	23	7	119	11
Bw---- 10 to 26	A-2	SC	100	100	83	24	15	11	9	22	7	118	11
C2---- 37 to 60	A-2	SM	100	100	71	17	10	7	6	18	2	120	11
Armo loam: (S82KS-147-001)													
A----- 0 to 16	A-6	CL	100	100	92	81	53	32	19	37	14	99	21
Bw---- 16 to 26	A-6	CL	100	100	92	79	55	37	26	37	14	96	21
C----- 36 to 60	A-7	ML	100	100	87	73	59	46	34	41	15	98	22
Wakeen silt loam: (S82KS-147-002)													
A----- 0 to 8	A-6	CL	100	100	91	72	38	21	12	37	14	99	20
BC---- 16 to 33	A-6	CL	100	100	92	80	64	51	38	40	17	101	22

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Anselmo	Coarse-loamy, mixed, mesic Typic Haplustolls
Armo	Fine-loamy, mixed, mesic Entic Haplustolls
Bogue	Very fine, montmorillonitic, mesic Udorthentic Pellusterts
Bridgeport	Fine-silty, mixed, mesic Fluventic Haplustolls
Brownell	Loamy-skeletal, carbonatic, mesic Entic Haplustolls
Campus	Fine-loamy, mixed, mesic Typic Calciustolls
Canlon	Loamy, mixed (calcareous), mesic Lithic Ustorthents
Detroit	Fine, montmorillonitic, mesic Pachic Argiustolls
Harney	Fine, montmorillonitic, mesic Typic Argiustolls
Heizer	Loamy-skeletal, carbonatic, mesic Lithic Haplustolls
Hobbs	Fine-silty, mixed, nonacid, mesic Mollic Ustifluvents
Holdrege	Fine-silty, mixed, mesic Typic Argiustolls
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Inavale	Sandy, mixed, mesic Typic Ustifluvents
McCook	Coarse-silty, mixed, mesic Fluventic Haplustolls
Munjor	Coarse-loamy, mixed (calcareous), mesic Typic Ustifluvents
Nibson	Loamy, carbonatic, mesic, shallow Entic Haplustolls
Penden	Fine-loamy, mixed, mesic Typic Calciustolls
Roxbury	Fine-silty, mixed, mesic Cumulic Haplustolls
Roxbury Variant	Clayey over loamy, montmorillonitic (calcareous), mesic Mollic Fluvaquents
Uly	Fine-silty, mixed, mesic Typic Haplustolls
Valentine	Mixed, mesic Typic Ustipsamments
Wakeen	Fine-silty, carbonatic, mesic Entic Haplustolls

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group)

Map symbol	Map unit	Land capability* N	Land capability* I	Prime farmland*	Range site
Am	Anselmo fine sandy loam, 1 to 3 percent slopes	IIe	IIe	Yes	Sandy.
An	Anselmo fine sandy loam, 3 to 7 percent slopes	IIIe	IIIe	Yes	Sandy.
Ar	Armo loam, 2 to 6 percent slopes	IIIe	---	Yes	Limy Upland.
Bo	Bogue silty clay, 6 to 12 percent slopes	VIe	---	No	Blue Shale.
Br	Bridgeport silt loam, 0 to 2 percent slopes	IIc	I	Yes	Loamy Terrace.
Bw	Brownell-Heizer gravelly loams, 7 to 20 percent slopes	VIIs	---	No	
	Brownell				Limy Upland.
	Heizer				Shallow Limy.
Cc	Campus-Canlon loams, 5 to 20 percent slopes	VIe	---	No	
	Campus				Limy Upland.
	Canlon				Shallow Limy.
De	Detroit silty clay loam	IIc	I	Yes	Loamy Terrace.
Ha	Harney silt loam, 0 to 1 percent slopes	IIc	I	Yes	Loamy Upland.
Hb	Hobbs silt loam, channeled	Vw	---	No	Loamy Lowland.
Hg	Hobbs silt loam, occasionally flooded	IIw	IIw	Yes	Loamy Lowland.
Hn	Holdrege silt loam, 0 to 1 percent slopes	IIc	I	Yes	Loamy Upland.
Ho	Holdrege silt loam, 1 to 3 percent slopes	IIe	IIe	Yes	Loamy Upland.
Hw	Hord silt loam	IIc	I	Yes	Loamy Terrace.
In	Inavale loamy fine sand, occasionally flooded	IVe	IIIe	No	Sandy Lowland.
Ip	Inavale loamy fine sand, hummocky	VIe	IVe	No	Sands.
Mk	McCook silt loam	IIc	I	Yes	Loamy Terrace.
Mu	Munjor sandy loam, occasionally flooded	IIIw	---	Yes	Sandy Lowland.
Pe	Penden loam, 2 to 6 percent slopes	IIIe	---	Yes	Limy Upland.
Pt	Pits, quarries.				
Ro	Roxbury silt loam	IIc	I	Yes	Loamy Terrace.
Rp	Roxbury silt loam, channeled	Vw	---	No	Loamy Lowland.
Rs	Roxbury silt loam, occasionally flooded	IIw	IIw	Yes	Loamy Terrace.
Rv	Roxbury Variant silty clay, frequently flooded	Vw	---	No	---
Uc	Uly silt loam, 3 to 6 percent slopes	IIIe	IIIe	Yes	Loamy Upland.
Ud	Uly silt loam, 6 to 10 percent slopes	IVe	IVe	No	Loamy Upland.
Ue	Uly silt loam, 6 to 10 percent slopes, eroded	IVe	IVe	No	Loamy Upland.
Uh	Uly silt loam, 10 to 20 percent slopes	VIe	---	No	Loamy Upland.
Up	Uly-Penden complex, 7 to 20 percent slopes	VIe	---	No	
	Uly				Loamy Upland.
	Penden				Limy Upland.
Ve	Valentine loamy fine sand, 5 to 20 percent slopes	VIe	---	No	Sands.
Wk	Wakeen-Nibson complex, 7 to 20 percent slopes	VIe	---	No	
	Wakeen				Limy Upland.
	Nibson				Limy Upland.

* A soil complex is treated as a single management unit in the land capability classification and prime farmland columns. The N column is for nonirrigated soils; the I column is for irrigated soils.

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