



United States
Department of
Agriculture

Soil
Conservation
Service

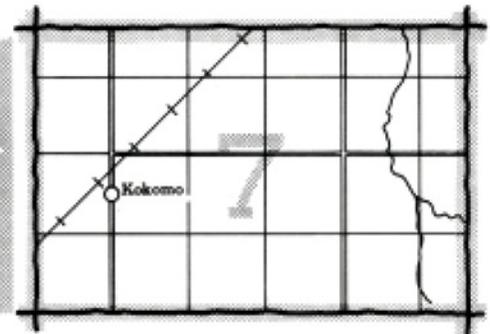
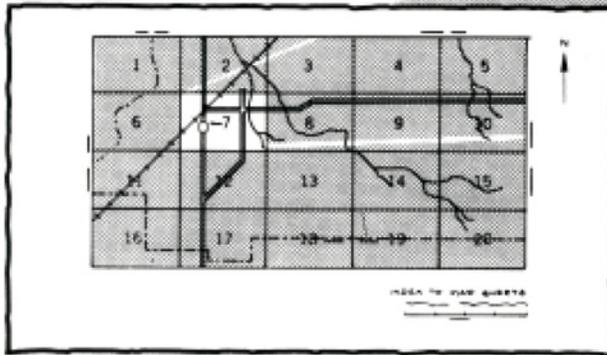
In cooperation with
Kansas
Agricultural
Experiment
Station

Soil Survey of McPherson County Kansas



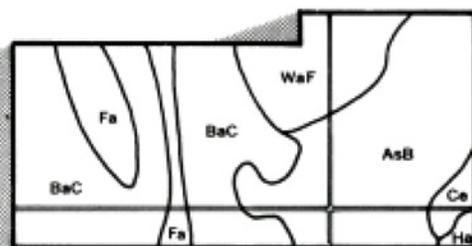
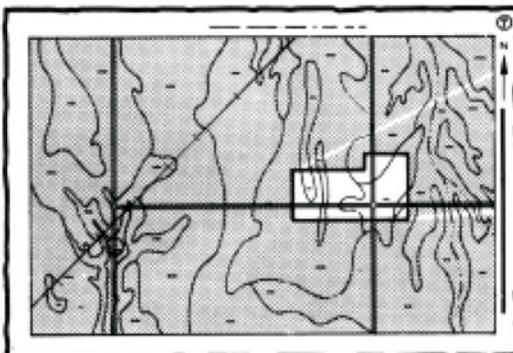
HOW TO USE

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

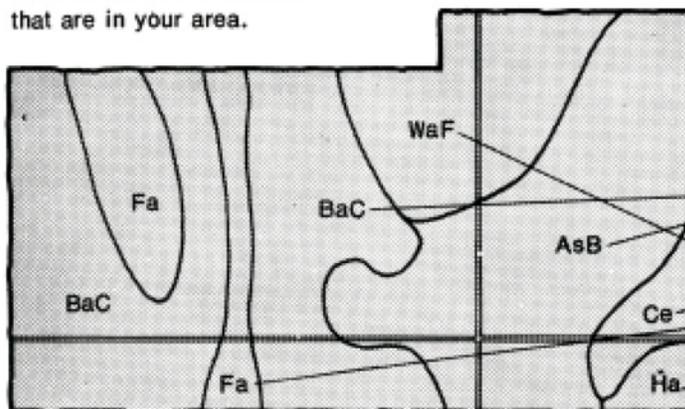


2. Note the number of the map sheet and turn to that sheet.

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



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

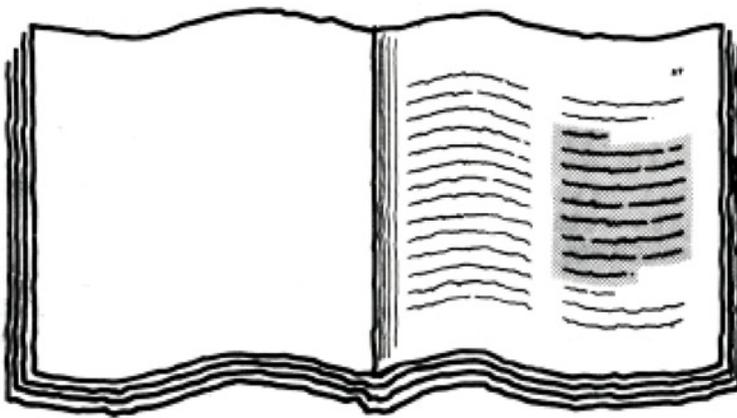


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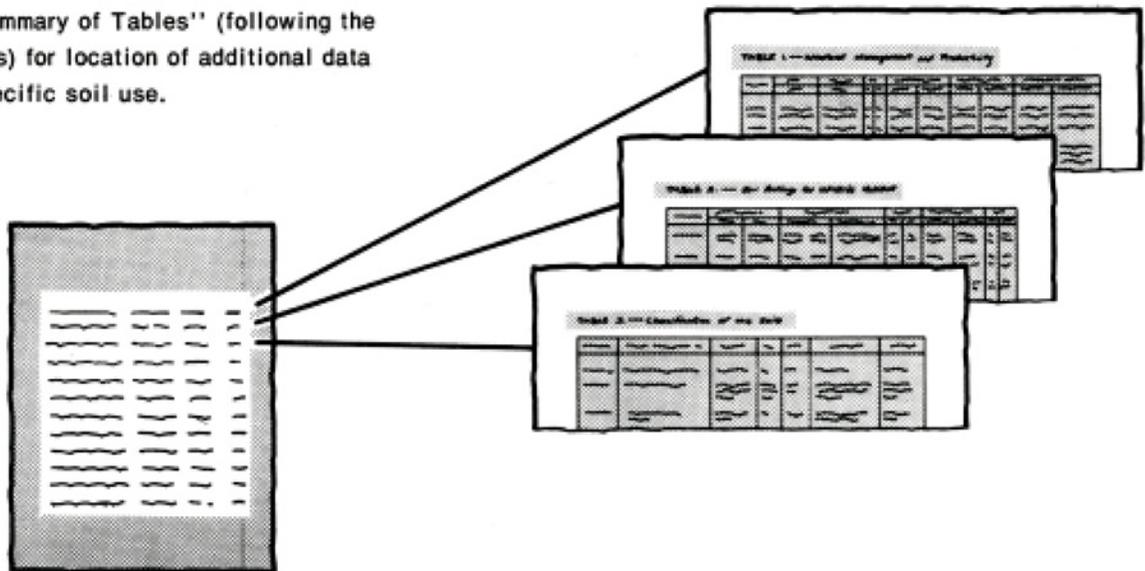
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THIS SOIL SURVEY

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.

A detailed view of the 'Index to Soil Map Units' table. It is a multi-column table with rows of text, likely listing map unit names and their corresponding page numbers. The text is too small to read clearly.

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.

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 McPherson County Conservation District. Financial assistance was provided by the McPherson County Commissioners. Major fieldwork was performed in the period 1973-80. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980.

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. An area in McPherson County where grassed waterways, terraces, and field windbreaks help to control erosion and soil blowing. The dominant soil in this area is Crete silt loam, 1 to 3 percent slopes.

contents

Index to map units	iv	plantings.....	34
Summary of tables	v	Recreation.....	36
Foreword	vii	Wildlife habitat.....	36
General nature of the county.....	1	Engineering.....	38
How this survey was made.....	2	Soil properties	43
General soil map units	3	Engineering index properties.....	43
Soil descriptions.....	4	Physical and chemical properties.....	44
Detailed soil map units	9	Soil and water features.....	45
Soil descriptions.....	9	Classification of the soils	47
Prime farmland.....	28	Soil series and their morphology.....	47
Use and management of the soils	31	Formation of the soils	63
Crops and pasture.....	31	References	65
Rangeland.....	33	Glossary	67
Woodland, windbreaks, and environmental		Tables	73

soil series

Attica series.....	47	Irwin series.....	55
Bridgeport series.....	48	Ladysmith series.....	55
Carwile series.....	49	Lancaster series.....	56
Cass series.....	49	Longford series.....	57
Clime series.....	50	McCook series.....	58
Crete series.....	50	Ness series.....	58
Detroit series.....	51	New Cambria series.....	59
Drummond series.....	51	Plevna series.....	59
Edalgo series.....	52	Pratt series.....	59
Farnum series.....	52	Roxbury series.....	60
Geary series.....	53	Smolan series.....	60
Goessel series.....	53	Tobin series.....	61
Hedville series.....	54	Wells series.....	61
Hord series.....	54		

Issued April 1983

index to map units

At—Attica loamy fine sand, 1 to 4 percent slopes	9	Ir—Irwin silty clay loam, 1 to 3 percent slopes.....	19
Br—Bridgeport silt loam	10	La—Ladysmith silty clay loam, 0 to 1 percent slopes	20
Ca—Carwile fine sandy loam.....	11	Ld—Ladysmith-Drummond complex	20
Cb—Cass fine sandy loam.....	12	Le—Lancaster loam, 2 to 6 percent slopes.....	21
Ce—Clime silty clay, 1 to 3 percent slopes	12	Lh—Lancaster-Hedville loams, 6 to 12 percent	
Cm—Clime silty clay, 3 to 6 percent slopes	13	slopes.....	21
Cr—Crete silt loam, 0 to 1 percent slopes.....	13	Ln—Longford silty clay loam, 3 to 6 percent slopes ..	22
Cs—Crete silt loam, 1 to 3 percent slopes.....	14	Lo—Longford silty clay loam, 2 to 6 percent slopes,	
Ct—Crete silty clay loam, 1 to 3 percent slopes,		eroded.....	22
eroded.....	15	Mc—McCook fine sandy loam.....	23
De—Detroit silty clay loam.....	15	Ns—Ness silty clay	23
Dr—Drummond loam	16	Nw—New Cambria silty clay.....	24
Ed—Edalgo silt loam, 5 to 12 percent slopes	16	Pa—Plevna fine sandy loam	25
Ee—Edalgo silty clay loam, 3 to 9 percent slopes,		Pr—Pratt loamy fine sand, rolling.....	26
eroded.....	17	Ro—Roxbury silty clay loam	26
Fa—Farnum loam, 1 to 3 percent slopes	17	Sm—Smolan silty clay loam, 1 to 3 percent slopes ...	26
Ge—Geary silt loam, 1 to 3 percent slopes	18	To—Tobin silt loam, occasionally flooded	27
Go—Goessel silty clay	18	Wb—Wells loam, 1 to 3 percent slopes.....	27
Ho—Hord silt loam.....	19	Wc—Wells loam, 3 to 6 percent slopes.....	28

summary of tables

Temperature and precipitation (table 1).....	74
Freeze dates in spring and fall (table 2).....	75
<i>Probability. Minimum temperature.</i>	
Growing season (table 3).....	75
<i>Probability. Daily minimum temperature during growing season.</i>	
Acreage and proportionate extent of the soils (table 4).....	76
<i>Acres. Percent.</i>	
Yields per acre of crops and pasture (table 5).....	77
<i>Grain sorghum. Winter wheat. Alfalfa hay. Corn. Smooth bromegrass.</i>	
Rangeland productivity and characteristic plant communities (table 6).....	79
<i>Range site name. Total production. Characteristic vegetation. Composition.</i>	
Windbreaks and environmental plantings (table 7).....	83
Recreational development (table 8).....	86
<i>Camp areas. Picnic areas. Playgrounds. Paths and trails.</i>	
Wildlife habitat potentials (table 9).....	88
<i>Potential for habitat elements. Potential as habitat for—Openland wildlife, Wetland wildlife, Rangeland wildlife.</i>	
Building site development (table 10).....	90
<i>Shallow excavations. Dwellings without basements. Dwellings with basements. Small commercial buildings. Local roads and streets.</i>	
Sanitary facilities (table 11).....	92
<i>Septic tank absorption fields. Sewage lagoon areas. Trench sanitary landfill. Area sanitary landfill. Daily cover for landfill.</i>	
Construction materials (table 12).....	94
<i>Roadfill. Sand. Gravel. Topsoil.</i>	
Water management (table 13).....	96
<i>Limitations for—Pond reservoir areas; Embankments, dikes, and levees. Features affecting—Drainage, Irrigation, Terraces and diversions, Grassed waterways.</i>	
Engineering index properties (table 14).....	98
<i>Depth. USDA texture. Classification—Unified, AASHTO. Fragments greater than 3 inches. Percentage passing sieve number—4, 10, 40, 200. Liquid limit. Plasticity index.</i>	

Physical and chemical properties of the soils (table 15)	101
<i>Depth. Clay. Moist bulk density. Permeability. Available water capacity. Soil reaction. Salinity. Shrink-swell potential. Erosion factors. Wind erodibility group. Organic matter.</i>	
Soil and water features (table 16).....	103
<i>Hydrologic group. Flooding. High water table. Bedrock. Potential frost action. Risk of corrosion.</i>	
Classification of the soils (table 17).....	105
<i>Family or higher taxonomic class.</i>	

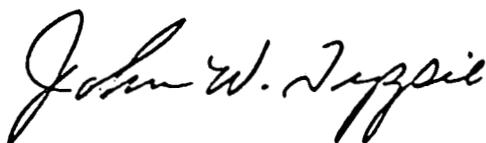
foreword

This soil survey contains information that can be used in land-planning programs in McPherson County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, 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 insure 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 McPherson County, Kansas

By Donald E. Rott, Soil Conservation Service

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

general nature of the county

MCPHERSON COUNTY is near the center of Kansas (fig. 1). It has a total area of 573,440 acres, or 896 square miles. The population was 26,234 in 1978. In that year, McPherson, the county seat, had a population of 11,114. The county was organized in 1870.

The northern part of the county is in the Central Kansas Sandstone Hills land resource area, and the southern part is in the Central Loess Plains land resource area. Generally, the soils are deep, are nearly level to moderately sloping, and have a silty or clayey subsoil. Elevation ranges from 1,265 to 1,690 feet above sea level. Most of the county is drained by the Little Arkansas and Smoky Hill Rivers and their tributaries.

The main enterprises in the county are farming and ranching. Wheat and grain sorghum are the principal crops. Petroleum production also is a major enterprise. A large amount of liquified petroleum gas is stored in

underground caverns. Some manufacturing plants are located in McPherson and Moundridge.

climate

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

The climate of McPherson County is typical continental, as can be expected of a location in the interior of a large land mass in the middle latitudes. It is characterized by large daily and annual variations in temperature. Winter is cold because of frequent outbreaks of polar air, but it lasts only from December through February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops commonly grown in the county. Spring and fall generally are short.

The county generally is along the western edge of the flow of moisture-laden air from the Gulf of Mexico. Shifts in this current result in a somewhat wide range in the annual amount of precipitation. The precipitation is heaviest during the period May through September. A large part of it falls during late-evening or nighttime thunderstorms. In dry years the amount is marginal for farming. Even in wet years, prolonged periods without rain commonly result in reduced productivity.

Tornadoes and severe thunderstorms strike occasionally, but they usually are local in extent and of short duration, so that the risk of crop damage is small. Hail falls during the warmer part of the year. The hailstorms are infrequent, however, and of local extent. They cause less crop damage than the hailstorms in the western part of the state.

Table 1 gives data on temperature and precipitation for the survey area as recorded at McPherson in the

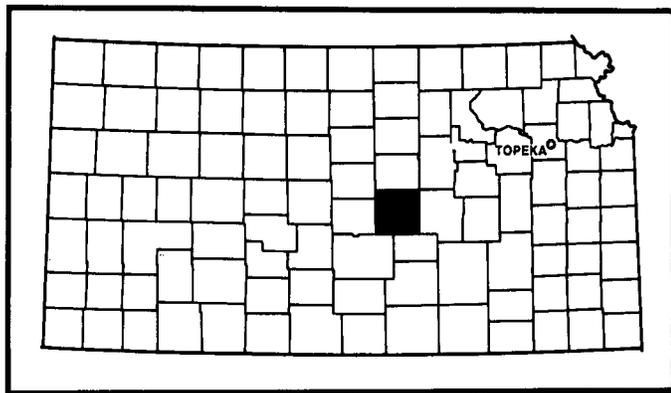


Figure 1.—Location of McPherson County in Kansas.

period 1951 to 1976. 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 32.9 degrees F, and the average daily minimum temperature is 22 degrees. The lowest temperature on record, which occurred at McPherson on February 12, 1899, is -27 degrees. In summer the average temperature is 78.5 degrees, and the average daily maximum temperature is 91.4 degrees. The highest recorded temperature, which occurred at McPherson on several dates, the last being August 12, 1936, is 117 degrees.

The total annual precipitation is 28.93 inches. Of this, 21.33 inches, or 74 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 14.93 inches. The heaviest 1-day rainfall was 11.39 inches at Lindsborg on October 20, 1941.

Average seasonal snowfall is 19.1 inches. The greatest snowfall, 57.3 inches, occurred at Lindsborg during the winter of 1959-60. On an average of 17 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The sun shines 75 percent of the time possible in summer and 63 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13.5 miles per hour, in April.

natural resources

Soil is the most important natural resource in the county. Most of the soils are fertile and are suited to farming. Ground water underlies most of the county, but irrigation water of suitable quantity and quality is limited mainly to the valley of the Smoky Hill River and to the Equus Bed Region, which is in the central and south-central parts of the county.

Other natural resources are oil, native grasses, sand and gravel, and wildlife. Sand and gravel are available in pits along the Smoky Hill River and in areas of sandy soils on the uplands in the northern part of the county.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

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, it 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, or variations in the extent of the soils in the counties.

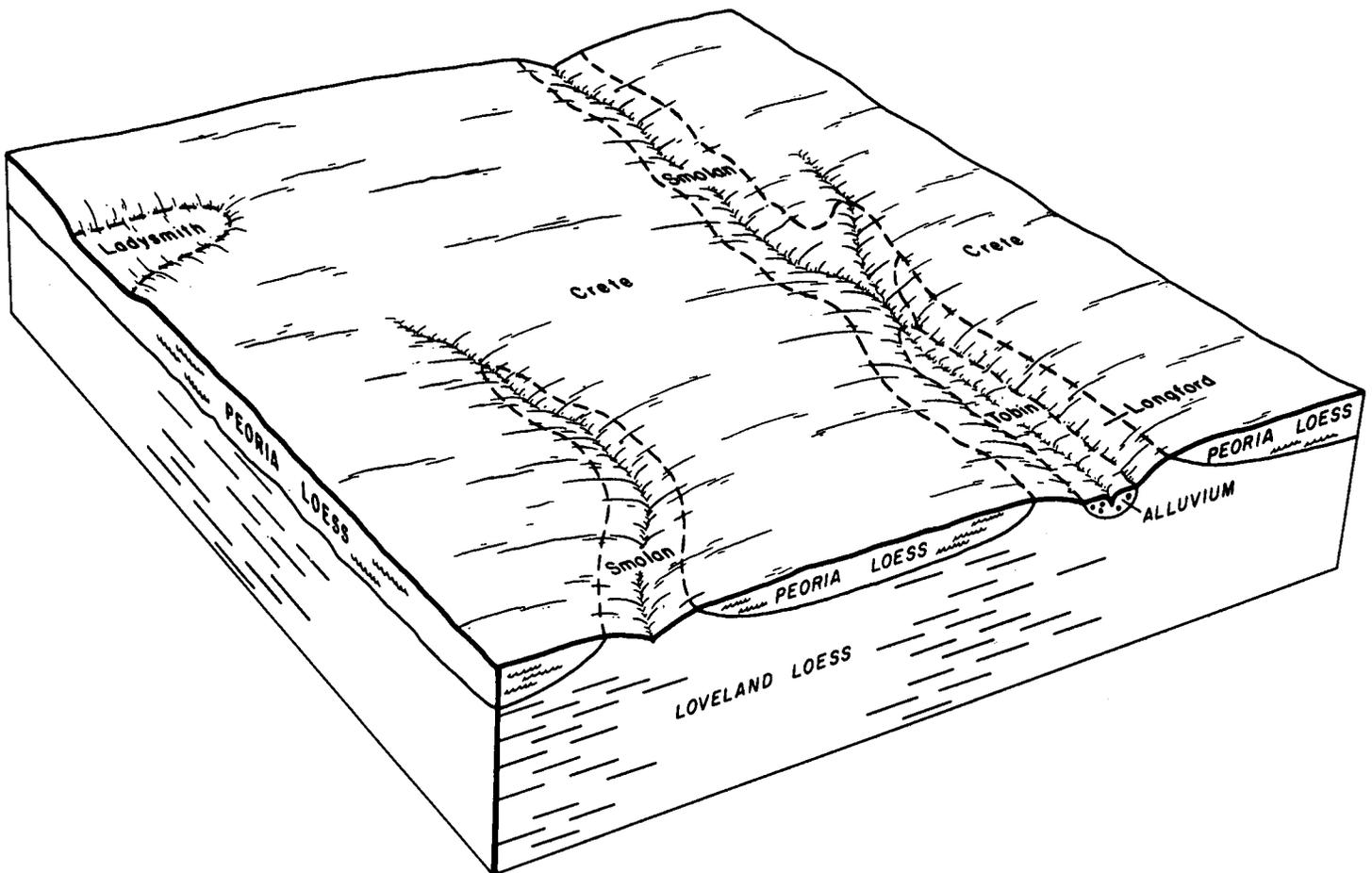


Figure 2.—Typical pattern of soils in the Crete-Smolon association.

soil descriptions

1. Crete-Smolan association

Deep, nearly level and gently sloping, moderately well drained soils that have a dominantly clayey subsoil; on uplands

This association is on broad ridgetops and narrow side slopes dissected by drainageways and creeks. Slope ranges mainly from 0 to 3 percent.

This association makes up about 40 percent of the county. It is about 79 percent Crete soils, 11 percent Smolan soils, and 10 percent minor soils (fig. 2).

The Crete soils formed in loess. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 4 inches thick. The subsoil is about 33 inches thick. The upper part is very dark grayish brown, firm silty clay loam; the next part is dark grayish brown, very firm silty clay; and the lower part is grayish brown,

very firm silty clay. The substratum to a depth of about 60 inches is pale brown, mottled silty clay loam.

The Smolan soils formed in reddish brown loess. Typically, the surface layer is brown silty clay loam about 11 inches thick. The subsoil is silty clay about 36 inches thick. The upper part is firm and dark reddish gray, the next part is very firm and dark reddish gray, and the lower part is very firm and reddish brown. The substratum to a depth of about 60 inches is reddish brown silty clay.

Minor in this association are Ladysmith, Longford, and Tobin soils. Ladysmith soils are somewhat poorly drained and nearly level. The well drained Longford soils are on the steeper side slopes. The occasionally flooded Tobin soils are on narrow flood plains.

This association is used mainly for cultivated crops. Winter wheat and grain sorghum are the chief crops. Measures that help to control erosion, conserve moisture, and help to prevent deterioration of tilth are the main management needs.

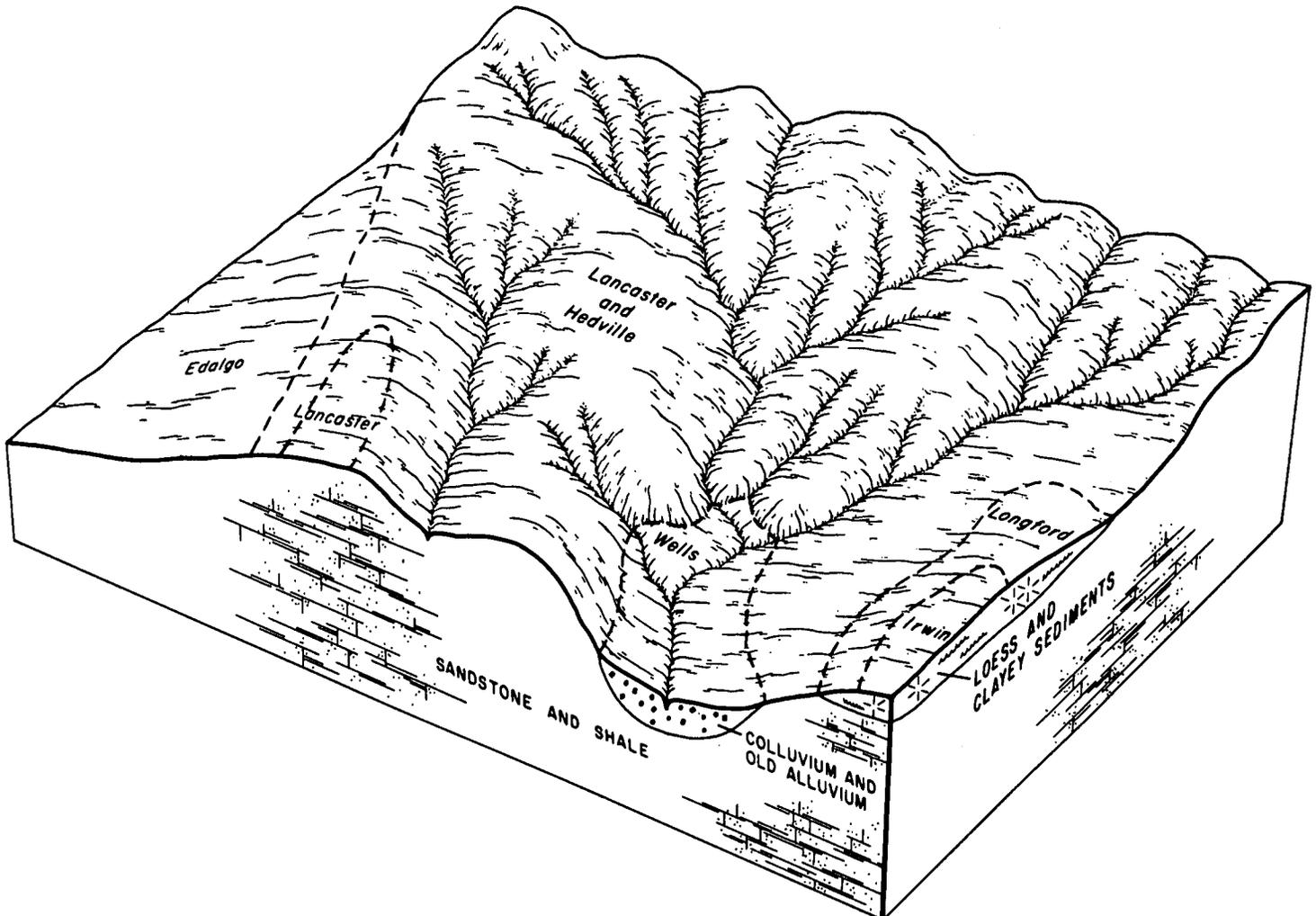


Figure 3.—Typical pattern of soils in the Lancaster-Hedville-Edalگو association.

2. Lancaster-Hedville-Edalگو association

Moderately deep and shallow, moderately sloping and strongly sloping, well drained and somewhat excessively drained soils that have a loamy or silty subsoil; on uplands

This association is on the tops and sides of ridges dissected by entrenched drainageways. Slope ranges mainly from 2 to 12 percent.

This association makes up about 21 percent of the county. It is about 35 percent Lancaster soils, 16 percent Hedville soils, 11 percent Edalگو soils, and 38 percent minor soils (fig. 3)

The moderately deep, well drained Lancaster soils formed in residuum of noncalcareous sandstone and sandy shale on ridgetops and side slopes. Typically, the surface layer is brown loam about 10 inches thick. The subsoil is about 22 inches thick. The upper part is brown, friable clay loam; the next part is reddish brown, firm clay loam; and the lower part is reddish yellow, mottled, firm sandy clay loam. Sandy shale and sandstone bedrock is at a depth of about 32 inches.

The shallow, somewhat excessively drained Hedville soils formed in residuum of noncalcareous sandstone on narrow ridgetops and the upper side slopes. Typically, the surface layer is dark grayish brown loam about 11 inches thick. The subsurface layer is brown loam about 4 inches thick. Sandstone bedrock is at a depth of about 15 inches.

The moderately deep, well drained Edalگو soils formed in residuum of clayey shale on side slopes. Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is mottled silty clay loam about 24 inches thick. The upper part of the subsoil is dark grayish brown and friable, and the lower part is brown and firm. Shale bedrock is at a depth of about 30 inches.

Minor in this association are Clime, Irwin, Longford, Tobin, and Wells soils. The calcareous Clime soils are along drainageways. The deep Irwin and Longford soils are in gently sloping and moderately sloping areas on ridgetops and the upper side slopes. The occasionally flooded Tobin soils are on narrow flood plains. The deep Wells soils are on the lower side slopes.

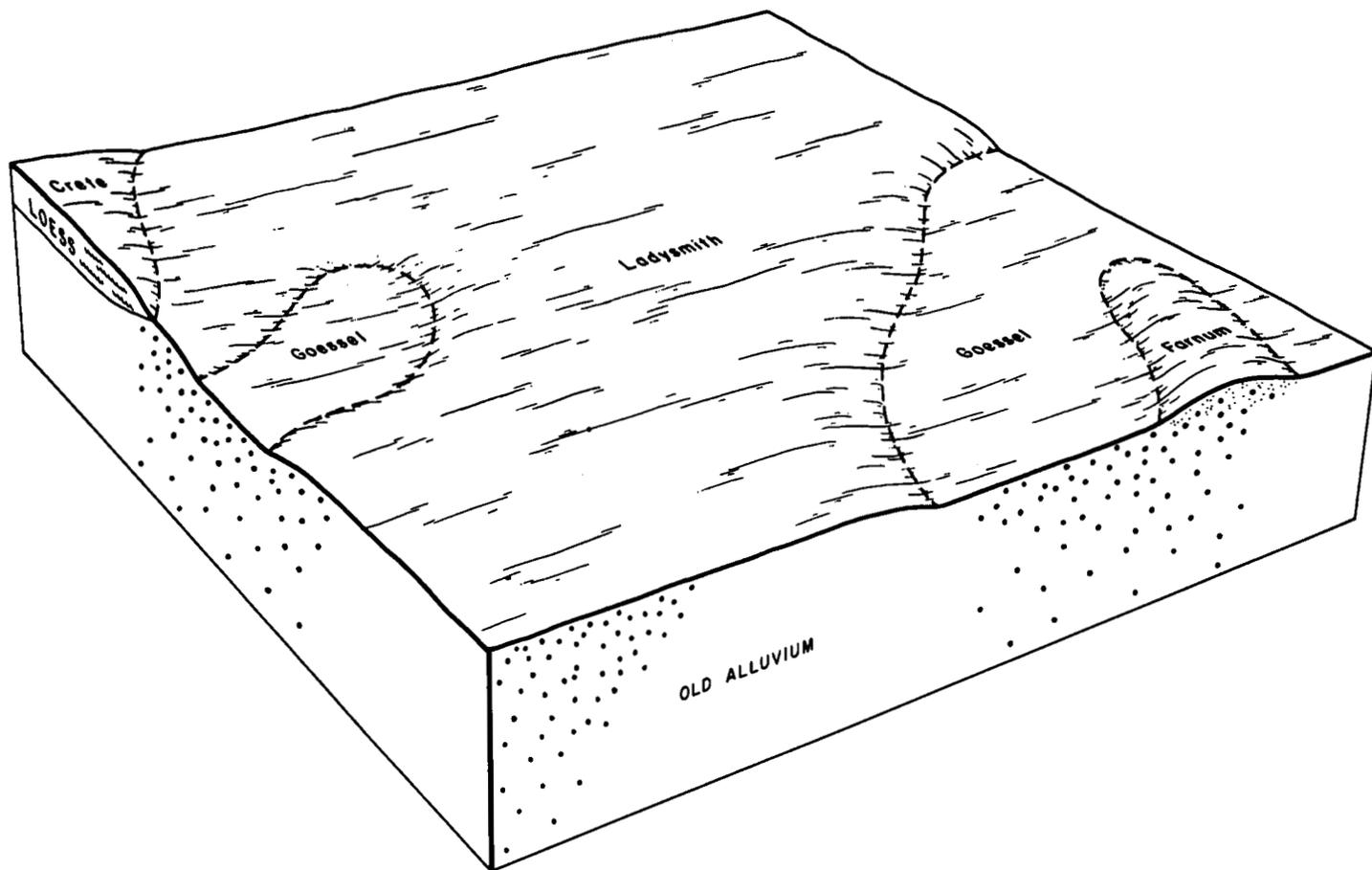


Figure 4.—Typical pattern of soils in the Ladysmith-Goessel association.

This association is used mainly as range. Some of the less sloping areas, however, are used for cultivated crops, chiefly winter wheat and grain sorghum. Controlling erosion and conserving moisture are the main management needs in the cultivated areas. Measures that help to prevent the invasion of undesirable grasses are needed in the areas used as range.

3. Ladysmith-Goessel association

Deep, nearly level, somewhat poorly drained and moderately well drained soils that have a clayey subsoil; on uplands

This association is on broad uplands. In some areas the nearly level terrain is interrupted by loamy mounds. Slope ranges mainly from 0 to 2 percent.

This association makes up about 20 percent of the county. It is about 60 percent Ladysmith soils, 16 percent Goessel soils, and 24 percent minor soils (fig. 4).

The somewhat poorly drained Ladysmith soils formed

in fine textured sediments. Typically, the surface layer is dark gray silty clay loam about 8 inches thick. The subsoil is mottled, very firm clay about 40 inches thick. The upper part is dark gray, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is light gray, mottled silty clay.

The moderately well drained Goessel soils formed in clayey old alluvium. Typically, the surface layer is very dark gray silty clay about 7 inches thick. The subsurface layer is very dark gray, very firm silty clay about 7 inches thick. The next 36 inches is dominantly dark gray, mottled, very firm silty clay. The substratum to a depth of about 60 inches is gray, mottled silty clay.

Minor in this association are Crete and Farnum soils. The moderately well drained, silty Crete soils are on the slightly higher parts of the landscape. The loamy Farnum soils are on mounds.

This association is used mainly for cultivated crops, but a few small areas are used for range or meadows.

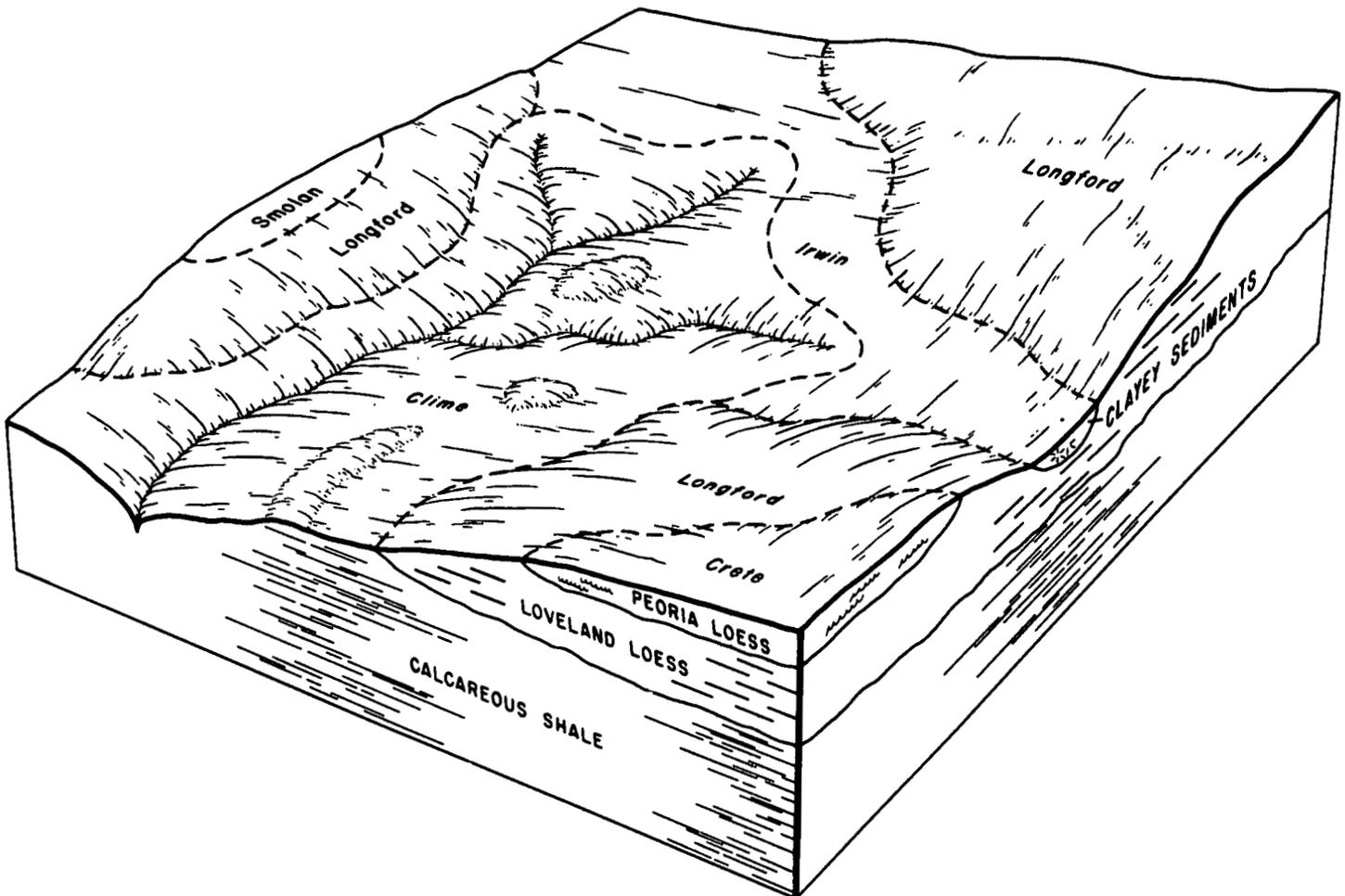


Figure 5.—Typical pattern of soils in the Longford-Clime-Irwin association.

Winter wheat and grain sorghum are the chief crops. Measures that help to prevent deterioration of tilth and conserve moisture are the main management needs.

4. Longford-Clime-Irwin association

Deep and moderately deep, gently sloping and moderately sloping, well drained and moderately well drained soils that have a dominantly clayey subsoil; on uplands

This association is on the tops and sides of ridges dissected by small drainageways. Slope ranges mainly from 1 to 6 percent.

This association makes up about 8 percent of the county. It is about 32 percent Longford soils, 24 percent Clime soils, 17 percent Irwin soils, and 27 percent minor soils (fig. 5).

The deep, well drained Longford soils formed in loess. Typically, the surface layer is dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 37 inches thick. The upper part is reddish brown, firm silty clay loam; the next part is reddish brown, very firm silty clay; and the lower part is brown, very firm silty clay. The substratum to a depth of about 60 inches is brown, mottled silty clay loam.

The moderately deep, well drained Clime soils formed in material weathered from calcareous, clayey shale. Typically, the surface layer is dark grayish brown silty clay about 9 inches thick. The subsoil is grayish brown, mottled, very firm silty clay about 6 inches thick. The substratum is light gray, mottled silty clay about 12 inches thick. Shale bedrock is at a depth of about 27 inches.

The deep, moderately well drained Irwin soils formed in clayey sediments or in residuum of shale. Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsurface layer is very dark grayish brown, firm silty clay loam about 5 inches thick. The subsoil is about 31 inches thick. It is very firm. The upper part is dark grayish brown clay, the next part is grayish brown clay, and the lower part is light brownish gray silty clay. Shale bedrock is at a depth of about 42 inches.

Minor in this association are Crete, Edalgo, Geary, and Smolan soils. The deep Crete, Geary, and Smolan soils are on ridgetops and the upper side slopes. The moderately deep, strongly sloping, silty Edalgo soils are on side slopes.

This association is used mainly for cultivated crops, but some areas are used for hay or pasture. Winter wheat, grain sorghum, and alfalfa are the chief crops. Measures that help to control erosion, prevent deterioration of tilth, and maintain the level of fertility are the main management needs.

5. Hord-Tobin-Bridgeport association

Deep, nearly level, well drained and moderately well drained soils that have a silty subsoil; on flood plains and terraces

This association is on flood plains and terraces dissected by the major streams in the county. Slope is dominantly 0 to 1 percent.

This association makes up about 9 percent of the county. It is about 25 percent Hord soils, 21 percent Tobin soils, 17 percent Bridgeport soils, and 37 percent minor soils.

The well drained Hord soils formed in silty alluvium on terraces. Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is friable silty clay loam about 30 inches thick. The upper part is dark grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown silty clay loam.

The moderately well drained Tobin soils formed in silty alluvium on flood plains. Typically, the surface soil is very dark grayish brown silt loam about 24 inches thick. The substratum to a depth of about 60 inches is dark grayish brown and grayish brown silt loam. It is mottled in the lower part.

The well drained Bridgeport soils formed in calcareous alluvium on terraces. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is light brownish gray, friable silt loam about 12 inches thick. The upper part of the substratum is light brownish gray silt loam. The lower part to a depth of about 60 inches is very pale brown loam.

Minor in this association are the loamy Cass soils, the moderately well drained Detroit soils, and the calcareous Roxbury soils. All of these soils are on terraces.

This association is used mainly for cultivated crops. Winter wheat and grain sorghum are the main dryland crops. Corn and grain sorghum are the main irrigated crops. Measures that prevent deterioration of tilth and maintain the level of fertility are the main management needs.

6. Carwile-Attica association

Deep, nearly level and gently sloping, somewhat poorly drained and well drained soils that have a loamy or sandy subsoil; on uplands

This association is on low ridges and in plane areas where drainageways are poorly defined. Slope ranges mainly from 0 to 4 percent.

This association makes up about 2 percent of the county. It is about 53 percent Carwile soils, 23 percent Attica soils, and 24 percent minor soils (fig. 6).

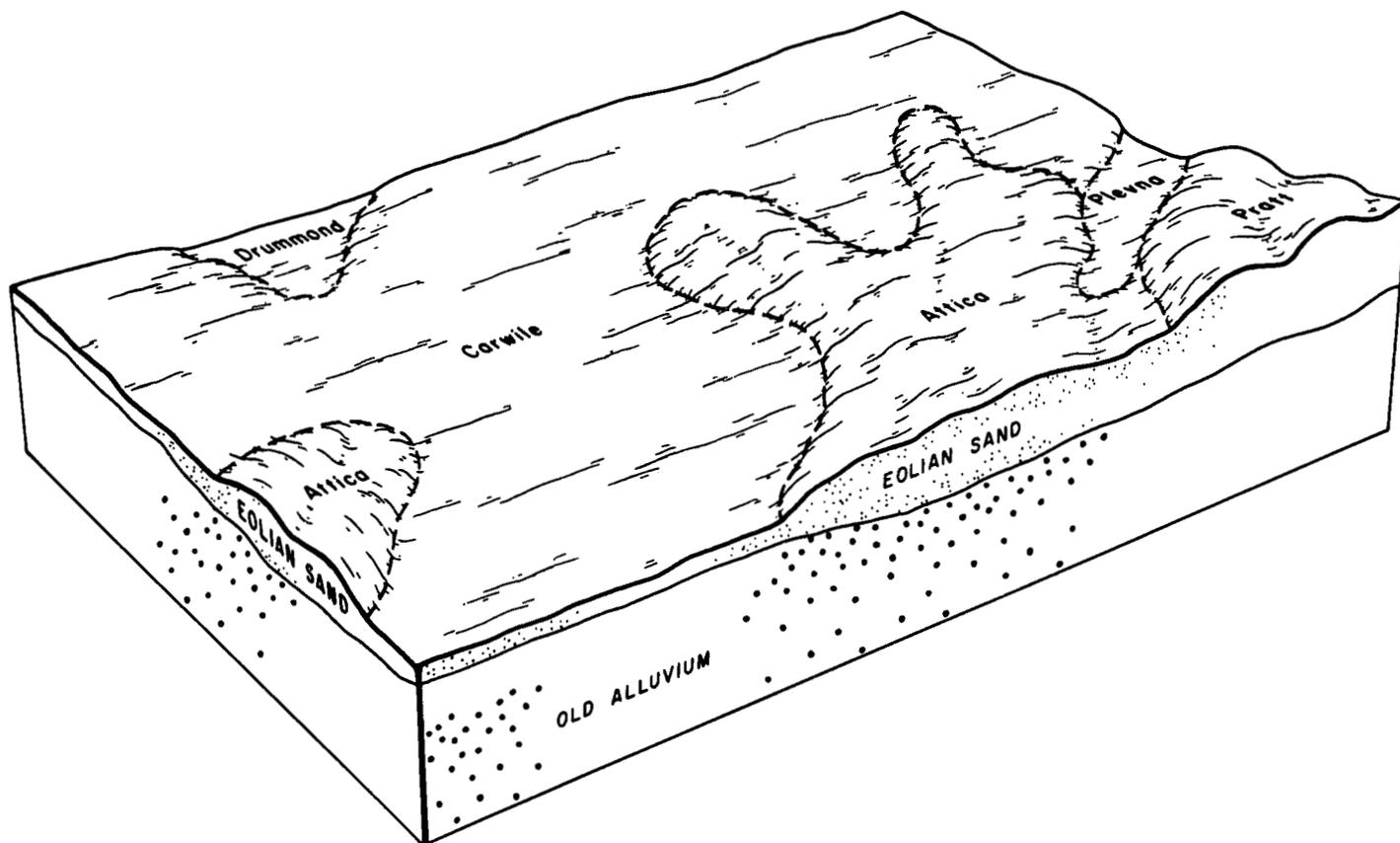


Figure 6.—Typical pattern of soils in the Carwile-Attica association.

The somewhat poorly drained Carwile soils formed in alluvium or eolian sediments in slight depressions. Typically, the surface layer is grayish brown fine sandy loam about 5 inches thick. The subsurface layer is about 16 inches thick. It is dark grayish brown and friable. The upper part is fine sandy loam, and the lower part is mottled loam. The subsoil is brown, mottled, very firm clay loam about 24 inches thick. The substratum to a depth of about 60 inches is light gray, mottled clay loam.

The well drained Attica soils formed in loamy and sandy eolian sediments on low ridges. Typically, the surface layer is brown loamy fine sand about 10 inches thick. The subsoil is about 35 inches thick. It is yellowish

brown. The upper part is friable fine sandy loam, and the lower part is very friable loamy fine sand. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand.

Minor in this association are Drummond, Plevna, and Pratt soils. Drummond soils are sodium affected and are nearly level. The poorly drained Plevna soils are in depressions. Pratt soils are sandy and rolling.

This association is used mainly for cultivated crops, but many areas are used as range. Winter wheat and grain sorghum are the chief crops. Soil blowing is the major hazard, especially on the ridges. Conserving moisture and maintaining the level of fertility are other concerns of management.

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 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 identifies 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, Crete silt loam, 0 to 1 percent slopes, is one of several phases in the Crete 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 that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Ladysmith-Drummond complex 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. These dissimilar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed 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, or 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.

soil descriptions

At—Attica loamy fine sand, 1 to 4 percent slopes.

This deep, undulating, well drained soil is on low upland ridges. Individual areas are irregular in shape and range from about 10 to 200 acres in size.

Typically, the surface layer is brown loamy fine sand about 10 inches thick. The subsoil is about 35 inches thick. It is yellowish brown. The upper part is friable fine sandy loam, and the lower part is very friable loamy fine sand. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand. In some areas the subsoil is loamy fine sand throughout.

Included with this soil in mapping are small areas of the somewhat poorly drained Carwile and poorly drained Plevna soils, which make up about 15 percent of the unit. These nearly level soils are in depressions or other low areas.

Permeability is moderately rapid in the Attica soil, and runoff is slow. Available water capacity is moderate. Organic matter content is low. The surface layer is very friable and can be easily tilled. It is medium acid.

Most areas are used for cultivated crops. A few are used for orchards and truck gardens (fig. 7). This soil is moderately well suited to wheat and grain sorghum. Measures that conserve moisture and help to control soil blowing are the main management needs. Examples are minimum tillage, wind stripcropping, and a protective cover of crop residue.

This soil is well suited to dwellings, septic tank absorption fields, and local roads and streets. It generally is unsuitable as a site for sewage lagoons, however, because of seepage.

The capability subclass is IIIe.



Figure 7.—A young apple orchard on Attica loamy fine sand, 1 to 4 percent slopes.

Br—Bridgeport silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from about 30 to 500 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is light brownish gray, friable silt loam about 12 inches thick. The upper part of the substratum is light brownish gray silt loam. The lower part to a depth of about 60 inches is very pale brown loam. The soil generally is calcareous throughout, but in a few areas the surface layer and subsoil are noncalcareous.

Included with this soil in mapping are small areas of the clayey New Cambria soils. These soils make up about 5 percent of the unit. They are in concave areas.

Permeability is moderate in the Bridgeport soil, and runoff is slow. Available water capacity is high. Organic matter content is moderately low. Tilth is good. The surface layer is neutral or mildly alkaline.

Most areas are used for cultivated crops. A few small areas adjacent to streams are wooded. This soil is well

sued to dryland and irrigated crops. Wheat, grain sorghum, and alfalfa are the main dryland crops. Measures that help to prevent deterioration of tilth and maintain the fertility level and the content of organic matter are the main management needs. Examples are minimum tillage and a cover of crop residue.

The chief irrigated crops are alfalfa, corn, and grain sorghum. The main management needs are the efficient use of irrigation water and measures that maintain the content of organic matter and the level of fertility and help to prevent deterioration of tilth. Leaving crop residue on the surface is an example of these measures. Land leveling and water management improve water distribution.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, and other flood control structures are needed. The higher parts of the landscape should be selected as building sites. The soil is only moderately well suited to local roads and streets because of low strength. The roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil.



Figure 8.—An included light colored slick spot in an area of Carwile fine sandy loam.

Providing coarser grained base material helps to ensure better performance.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard in septic tank absorption fields. It can be controlled, however, by levees. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability class is I.

Ca—Carwile fine sandy loam. This deep, nearly level, somewhat poorly drained soil is on slightly depressional uplands. It is subject to ponding. Individual areas are irregular in shape and range from about 10 to more than 1,000 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 5 inches thick. The subsurface layer is about 16 inches thick. It is dark grayish brown and friable. The upper part is fine sandy loam, and the lower part is mottled loam. The subsoil is brown, mottled, very firm clay loam about 24 inches thick. The substratum to a depth of about 60 inches is light gray, mottled clay loam.

Included with this soil in mapping are small areas of

Attica, Plevna, and Pratt soils and slick spots (fig. 8). These included areas make up about 15 percent of the unit. The well drained Attica and Pratt soils are on the higher parts of the landscape. The poorly drained Plevna soils are in depressions. The slick spots are slightly lower on the landscape than the Carwile soil or in similar positions.

Permeability is slow in the Carwile soil, and runoff is slow to ponded. A seasonal high water table is near or above the surface. Available water capacity is high. Organic matter content is moderately low. Tilth is good. The surface layer is neutral or slightly acid. The shrink-swell potential is high in the subsoil.

Most areas are cultivated, but some small areas are used as range and a few areas are used for orchards and truck gardens. This soil is well suited to wheat, grain sorghum, and alfalfa. The main concerns of management are wetness in low areas during periods of high rainfall and soil blowing during periods of low rainfall. Stripcropping and a protective cover of crop residue help to control soil blowing. Drainage ditches help to remove excess surface water.

This soil is poorly suited to dwellings and local roads

and streets. The shrink-swell potential and the ponding are limitations. Also, low strength is a limitation on sites for local roads and streets. The sandy included soils on mounds are better sites for dwellings. Building roads on raised, well compacted fill material, establishing adequate side ditches, and installing culverts help to prevent the road damage caused by ponding. Providing coarser grained base material helps to prevent the damage caused by shrinking and swelling and by low strength.

This soil generally is unsuitable as a septic tank absorption field because of the slow permeability and the ponding. If the ponding is controlled, sewage lagoons are a suitable alternative method of onsite waste disposal.

The capability subclass is IIw.

Cb—Cass fine sandy loam. This deep, nearly level, well drained soil is on terraces. It generally is subject to rare flooding, but a few areas along narrow drainageways are occasionally flooded. Individual areas are irregular in shape and range from about 30 to 200 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 7 inches thick. The subsurface layer is friable fine sandy loam about 18 inches thick. The upper part is dark grayish brown, and the lower part is brown. The upper part of the substratum is brown fine sandy loam. The lower part to a depth of about 60 inches is very pale brown loamy fine sand.

Included with this soil in mapping are small areas of Bridgeport and Carwile soils, which make up about 10 percent of the unit. The calcareous Bridgeport soils are less sandy than the Cass soil. Their positions on the landscape are similar to those of the Cass soil. The somewhat poorly drained Carwile soils are slightly lower on the landscape than the Cass soil or are in similar positions.

Permeability is moderately rapid in the Cass soil, and runoff is slow. Available water capacity is moderate. Organic matter content is moderately low. The surface layer is very friable and can be easily tilled. It is slightly acid.

Most areas are used for cultivated crops, but a few small, inaccessible areas near streams are wooded. This soil is well suited to corn, grain sorghum, wheat, and alfalfa. Measures that help to control soil blowing and conserve moisture are the main management needs. Examples are leaving crop residue on the surface and minimizing tillage.

This soil generally is unsuited to most kinds of building site development and sanitary facilities because of the flooding. Overcoming this hazard is difficult without major flood control measures.

The capability subclass is IIc.

Ce—Clime silty clay, 1 to 3 percent slopes. This moderately deep, gently sloping, well drained soil is on the broad tops and sides of upland ridges. Individual areas are irregular in shape and range from about 20 to more than 200 acres in size.

Typically, the surface layer is dark grayish brown silty clay about 9 inches thick. The subsoil is grayish brown, mottled, very firm silty clay about 8 inches thick. The substratum is light gray, mottled silty clay about 13 inches thick. Shale bedrock is at a depth of about 30 inches. The soil is calcareous throughout. In a few places the depth to bedrock is less than 20 inches. In a few areas the bedrock is chalky limestone.

Included with this soil in mapping are small areas of Edalgo and Irwin soils, which make up 5 to 10 percent of the unit. Edalgo soils do not have lime in the subsoil. They are on the steeper side slopes. Irwin soils are more than 40 inches deep over bedrock. They are on ridgetops.

Permeability is slow in the Clime soil, and runoff is rapid. Available water capacity is low. Organic matter content is moderately low. The clayey surface layer is firm and cannot be easily tilled. If the surface layer is tilled when too wet or too dry, large clods form. The soil is moderately alkaline throughout. Root penetration is restricted by the shale at a depth of about 30 inches. The shrink-swell potential is moderate.

Most of the acreage is used for cultivated crops, but some areas are used as range. This soil is moderately well suited to wheat and sorghum. The low available water capacity and a hazard of erosion are the main concerns of management. Terraces, grassed waterways, and a protective cover of crop residue help to prevent excessive soil loss, conserve moisture, and improve tilth. Soil depth should be considered when terraces are designed. In a few areas where terraces have been built, the root zone is severely restricted because most of the soil overlying the bedrock has been removed.

This soil is suited to range. The dominant native vegetation is little bluestem and big bluestem. The less productive grasses, such as sideoats grama and blue grama, increase in extent if the range is overgrazed. Proper stocking rates, timely deferment of grazing, and rotation grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is moderately well suited to local roads and streets and to dwellings. The roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. The shrink-swell potential is a limitation on sites for dwellings. Also, the depth to bedrock is a limitation on sites for dwellings with basements. The rock generally is soft, however, and can be easily excavated. Properly designing and

reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling.

Because of the slow permeability and the depth to bedrock, this soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage lagoons because of the depth to bedrock. The deeper included soils are better sites.

The capability subclass is IIIe.

Cm—Clime silty clay, 3 to 6 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 30 to 150 acres in size.

Typically, the surface layer is dark grayish brown silty clay about 9 inches thick. The subsoil is grayish brown, mottled, very firm silty clay about 6 inches thick. The substratum is light gray, mottled silty clay about 12 inches thick. Shale bedrock is at a depth of about 27 inches. The soil is calcareous throughout. In some areas soft limestone fragments are on the surface. In other areas the depth to bedrock is less than 20 inches.

Included with this soil in mapping are small areas of Edalgo, Lancaster, and Longford soils, which make up about 15 percent of the unit. Edalgo soils do not have lime in the subsoil. They are on the steeper side slopes. The loamy Lancaster soils are on the upper side slopes. The deep Longford soils are on ridgetops.

Permeability is slow in the Clime soil, and runoff is rapid. Available water capacity is low. Organic matter content is moderately low. The surface layer is firm and cannot be easily tilled. The soil is moderately alkaline throughout. Root penetration is restricted by the shale at a depth of about 27 inches. The shrink-swell potential is moderate.

Most of the acreage is used as range, but some areas are used for cultivated crops. This soil is poorly suited to wheat and sorghum. If cultivated crops are grown, erosion is a severe hazard. Also, drought and poor tilth are concerns of management. Terraces, grassed waterways, and contour farming reduce the runoff rate and help to prevent excessive soil loss. Returning crop residue to the soil improves tilth, increases the organic matter content, and conserves moisture.

This soil is suited to range. The dominant native vegetation is little bluestem and big bluestem. The less productive grasses, such as sideoats grama and blue grama, increase in extent if the range is overgrazed. Proper stocking rates, timely deferment of grazing, and rotation grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland.

The many areas where cropland is adjacent to range can be managed as habitat for upland wildlife, such as

pheasants. Planting shrubs in these fringe areas provides winter cover for the wildlife.

This soil is moderately well suited to local roads and streets and to dwellings. The roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance. The shrink-swell potential is a limitation on sites for dwellings. Also, the depth to bedrock is a limitation on sites for dwellings with basements. The rock generally is soft, however, and can be easily excavated. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling.

Because of the slow permeability and the depth to bedrock, this soil generally is unsuitable as a septic tank absorption field. It is poorly suited to seepage lagoons because of the depth to bedrock. The deeper included soils are better sites.

The capability subclass is IVe.

Cr—Crete silt loam, 0 to 1 percent slopes. This deep, nearly level, moderately well drained soil is on the broad tops of upland ridges. Individual areas are irregular in shape and range from about 20 to more than 1,000 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 4 inches thick. The subsoil is about 33 inches thick. The upper part is very dark grayish brown, firm silty clay loam; the next part is dark grayish brown, very firm silty clay; and the lower part is grayish brown, very firm silty clay. The substratum to a depth of about 60 inches is pale brown, mottled silty clay loam. In some areas the upper part of the subsoil is black silty clay.

Included with this soil in mapping are small areas of the clayey Goessel soils, which make up about 5 percent of the unit. These soils are in slightly concave areas.

Permeability is slow in the Crete soil. Runoff also is slow. Available water capacity is high. Organic matter content is moderate. Tilth is good. The surface layer is medium acid or slightly acid. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is suited to dryland and irrigated crops. Wheat and grain sorghum are the main dryland crops. The clayey subsoil restricts the movement of water into the soil and releases moisture slowly to plants. Minimizing tillage and leaving crop residue on the surface help to prevent surface compaction, improve fertility and tilth, and increase the infiltration rate.

The chief irrigated crops are corn and grain sorghum (fig. 9). The main management needs are the efficient



Figure 9.—A center-pivot irrigation system in an area of Crete silt loam, 0 to 1 percent slopes, used for grain sorghum.

use of irrigation water and measures that maintain the organic matter content and the fertility level. Returning crop residue to the soil is an example of these measures. Land leveling and water management improve water distribution.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. The roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field or installing the distribution lines below the clayey subsoil, however, helps to overcome this limitation. Seepage is a limitation on sites for sewage lagoons. It can be

controlled, however, by sealing the lagoon. The clayey subsoil may be suitable sealing material.

The capability subclass is IIs.

Cs—Crete silt loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on the broad tops and sides of upland ridges. Individual areas are irregular in shape and range from about 30 to more than 1,000 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, firm silty clay loam about 4 inches thick. The subsoil is about 30 inches thick. The upper part is very dark grayish brown, firm silty clay loam; the next part is dark grayish brown, very firm silty clay; and the lower part is grayish brown, very firm silty clay. The substratum to a depth of about 60 inches is pale brown silty clay loam. In some areas the subsoil is reddish brown.

Included with this soil in mapping are small areas of the well drained Farnum soils on the narrow tops and sides of the ridges. These soils make up about 10 percent of the unit.

Permeability is slow in the Crete soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate. Tilth is good. The surface layer is medium acid or slightly acid. The shrink-swell potential is high in the subsoil.

Most areas are cultivated. A few are irrigated. This soil is well suited to cultivated crops. Wheat and grain sorghum are the main dryland crops. If cultivated crops are grown, erosion is a hazard. Also, the clayey subsoil restricts the movement of water into the soil and releases moisture slowly to plants. Minimizing tillage and returning crop residue to the soil conserve moisture. Terraces and contour farming reduce the runoff rate and help to prevent excessive soil loss.

Corn and grain sorghum are the chief irrigated crops. If a gravity system of irrigation is used, some land leveling generally is needed before the irrigation water can be managed efficiently. The leveling should not expose the clayey subsoil. Controlling the rate of water application conserves irrigation water.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. The roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field or installing the distribution lines below the clayey subsoil, however, helps to overcome this limitation. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. The clayey subsoil may be suitable sealing material. Some land shaping commonly is needed.

The capability subclass is IIe.

Ct—Crete silty clay loam, 1 to 3 percent slopes, eroded. This deep, gently sloping, moderately well drained soil is on short side slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 29 inches thick. It is firm. The upper part is dark grayish brown silty clay loam, and the lower part is grayish brown silty clay. The substratum to a depth of about 60 inches is pale brown silty clay loam. In a few areas the

surface layer is silt loam. In some areas the subsoil is reddish brown.

Permeability is slow, and runoff is medium. Available water capacity is high. Organic matter content is moderately low. The surface layer is firm and cannot be easily tilled. It is medium acid. The shrink-swell potential is high in the subsoil.

Most of the acreage is used for cultivated crops, but some is abandoned cropland or is used as range. This soil is moderately well suited to wheat and sorghum. It is droughty because the clayey subsoil absorbs and releases moisture slowly. If cultivated crops are grown, further erosion is a hazard. Terraces, grassed waterways, contour farming, and a protective cover of crop residue help to prevent excessive soil loss, conserve moisture, and improve tilth.

This soil is suited to range. A cover of grasses is effective in controlling erosion. Abandoned cropland should be reseeded to native grass. Proper stocking rates and a uniform distribution of grazing help to keep the range in good condition.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. The roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with coarse material help to prevent the damage to buildings caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field or installing the distribution lines below the clayey subsoil, however, helps to overcome this limitation. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed.

The capability subclass is IIIe.

De—Detroit silty clay loam. This deep, nearly level, moderately well drained soil is on terraces. It is subject to rare flooding. Individual areas are long and narrow or irregularly shaped and range from about 40 to more than 200 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 13 inches thick. The subsoil is silty clay about 27 inches thick. The upper part is dark grayish brown and firm, and the lower part is grayish brown and very firm. The substratum to a depth of about 60 inches is light brownish gray, mottled silty clay loam.

Included with this soil in mapping are small areas of Hord, Roxbury, and Tobin soils. These soils make up about 15 percent of the unit. Their subsoil is less clayey than that of the Detroit soil. Hord and Roxbury soils are on the terraces, and Tobin soils are on flood plains.

Permeability is slow in the Detroit soil. Runoff also is slow. Available water capacity is high. Organic matter content is moderate. Tilth is good. The surface layer is slightly acid. The shrink-swell potential is high in the subsoil.

Most of the acreage is used for cultivated crops. This soil is well suited to wheat and grain sorghum. Conserving moisture is the main concern of management. Leaving crop residue on the surface and minimizing tillage help to maintain the organic matter content and conserve moisture.

Because of the flooding and the shrink-swell potential, this soil is poorly suited to dwellings. Dikes, levees, and other flood control structures are needed. Because of the flooding, the higher parts of the landscape should be selected as building sites. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage caused by shrinking and swelling.

This soil is moderately well suited to local roads and streets. Low strength and the shrink-swell potential are limitations. The surface pavement and base material should be thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the damage caused by shrinking and swelling.

This soil is well suited to sewage lagoons. It is poorly suited to septic tank absorption fields, however, because the slow permeability restricts the absorption of effluent. Enlarging the field helps to overcome this limitation.

The capability subclass is I.

Dr—Drummond loam. This deep, nearly level, somewhat poorly drained soil is on terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from about 40 to 320 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is about 23 inches thick. It is very firm. The upper part is dark gray clay, and the lower part is brown, mottled clay loam. The substratum to a depth of about 60 inches is brown, mottled clay loam.

Included with this soil in mapping are small areas of Carwile soils on uplands and Ladysmith soils on uplands and terraces. These soils make up 10 to 15 percent of the unit. They are not affected by excess sodium.

Permeability is very slow in the Drummond soil. Runoff also is very slow. Available water capacity is moderate. A seasonal high water table is at a depth of 2 to 6 feet. Organic matter content is moderately low. The surface layer is slightly acid. The subsoil is affected by excess

sodium. It has a high shrink-swell potential.

Most of the acreage is used as range, but a few small areas are cultivated. Because of the excessive content of sodium and other salts, this soil generally is unsuited to cultivated crops. It is best suited to range. The native vegetation dominantly is prairie cordgrass, switchgrass, indiagrass, and inland saltgrass. Overused areas are dominated by inland saltgrass. Measures that maintain or improve the stand of desirable grasses are needed. Examples are proper stocking rates, timely deferment of grazing, rotation grazing, and a uniform distribution of grazing.

The many areas where range is adjacent to cropland can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these fringe areas provides winter cover for the wildlife.

This soil generally is unsuited to most kinds of building site development and sanitary facilities because of the flooding and the wetness. Overcoming the flooding is difficult without major flood control measures.

The capability subclass is Vs.

Ed—Edalgo silt loam, 5 to 12 percent slopes. This moderately deep, strongly sloping, well drained soil is on upland side slopes dissected by small drainageways. Individual areas are irregular in shape and range from about 50 to more than 300 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsoil is mottled silty clay loam about 24 inches thick. The upper part is dark grayish brown and friable, and the lower part is brown and firm. Clayey shale bedrock is at a depth of about 30 inches. In some areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of Clime and Lancaster soils, which make up about 15 percent of the unit. The calcareous Clime soils are on the lower side slopes. Lancaster soils are in positions on the landscape similar to those of the Edalgo soil. Their subsoil is less clayey than that of the Edalgo soil.

Permeability is very slow in the Edalgo soil, and runoff is rapid. Available water capacity is low. Organic matter content is moderate. Tilth is good. The surface layer is medium acid. The shrink-swell potential is high in the subsoil.

Most of the acreage is used as range, but some areas are used for cultivated crops, mainly wheat and sorghum. This soil is poorly suited to cultivated crops because erosion is a severe hazard. Terraces, grassed waterways, contour farming, a protective cover of crop residue, and minimum tillage help to control erosion, maintain the organic matter content, and conserve moisture.

This soil is best suited to range. The native vegetation dominantly is big bluestem, little bluestem, and switchgrass. Overused areas are dominated by sideoats grama, blue grama, and buffalograss. Proper stocking

rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets, and in a few areas wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling. Installing foundation drains helps to prevent the damage caused by wetness. Roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the very slow permeability and the depth to bedrock, this soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage lagoons because of the depth to bedrock. The areas where the depth to bedrock is more than 40 inches are suitable sites for the lagoons.

The capability subclass is IVe.

Ee—Edalgo silty clay loam, 3 to 9 percent slopes, eroded. This moderately deep, moderately sloping, well drained soil is on the sides and narrow tops of upland ridges. Individual areas are irregularly shaped and winding and range from about 40 to 120 acres in size.

Typically, the surface layer is reddish brown silty clay loam about 8 inches thick. The subsoil is reddish brown, very firm silty clay loam about 15 inches thick. Clayey shale bedrock is at a depth of about 23 inches. In some areas, the surface layer is silty clay and the subsoil is dark gray. In other areas the depth to bedrock is less than 20 inches.

Included with this soil in mapping are small areas of Clime and Lancaster soils, which make up about 15 percent of the unit. The calcareous Clime soils are on the lower side slopes. Lancaster soils are in positions on the landscape similar to those of the Edalgo soil. Their subsoil is less clayey than that of the Edalgo soil.

Permeability is very slow in the Edalgo soil, and runoff is rapid. Available water capacity is low. Organic matter content is moderately low. The surface layer is firm and cannot be easily tilled. It is medium acid. Root penetration is restricted by the clayey shale at a depth of about 23 inches. The shrink-swell potential is high in the subsoil.

Most areas are used for cultivated crops, mainly wheat and sorghum, or are abandoned cropland. The rest are used as range. This soil is poorly suited to cultivated crops because further erosion is a hazard. Terraces, contour farming, and minimum tillage help to control runoff and erosion. Leaving crop residue on the surface

and adding barnyard manure increase the infiltration rate and improve tilth.

This soil is suited to range. A cover of grasses is effective in controlling erosion. Abandoned cropland should be reseeded to native grass. Proper stocking rates and rotation grazing help to keep the range in good condition.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets, and in a few areas wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling. Installing foundation drains helps to prevent the damage caused by wetness. Roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the very slow permeability and the depth to bedrock, this soil generally is unsuitable as a septic tank absorption field. It is poorly suited to sewage lagoons because of the depth to bedrock. Areas where the depth to bedrock is more than 40 inches are better sites for the lagoons.

The capability subclass is IVe.

Fa—Farnum loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on the long and narrow tops of upland ridges. Individual areas range from about 15 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsurface layer is dark grayish brown, friable loam about 6 inches thick. The subsoil is brown and pale brown, firm sandy clay loam about 37 inches thick. The substratum to a depth of about 60 inches is brown, mottled fine sandy loam. In some areas the subsoil is fine sandy loam.

Included with this soil in mapping are small areas of Crete and Goessel soils, which make up about 10 percent of the unit. These soils have a clayey subsoil. They are in the less sloping areas.

Permeability is moderate in the Farnum soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate. Tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Erosion is a hazard, however, if cultivated crops are grown. Terraces, grassed waterways, contour farming, a protective cover of crop residue, and minimum tillage help to control erosion, maintain the organic matter content, and prevent deterioration of tilth.

This soil is well suited to dwellings. The shrink-swell

potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material, however, help to prevent the damage caused by shrinking and swelling.

This soil is moderately well suited to local roads and streets. Low strength and the potential for frost action are limitations. Building the roads and streets on raised, well compacted fill material, establishing adequate side ditches, and installing culverts reduce wetness and thus help to prevent the damage caused by frost action. The surface pavement and base material should be thick enough to compensate for the low strength of the soil.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability somewhat restricts the absorption of effluent in septic tank absorption fields. Enlarging the field, however, commonly overcomes this limitation. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed.

The capability subclass is IIe.

Ge—Geary silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on uplands. Individual areas are irregular in shape and range from about 15 to 100 acres in size.

Typically, the surface layer is brown silt loam about 10 inches thick. The subsoil is firm silty clay loam about 29 inches thick. The upper part is brown, and the lower part is reddish brown. The substratum to a depth of about 60 inches is reddish yellow silty clay loam. In a few areas the surface layer is loam.

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

Permeability is moderate in the Geary soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate. Tilth is good. The surface layer is medium acid. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is cultivated. This soil is well suited to wheat, sorghum, and alfalfa. Erosion is a hazard, however, if cultivated crops are grown. Terraces, grassed waterways, contour farming, a protective cover of crop residue, and minimum tillage help to control erosion, maintain the organic matter content, and conserve moisture.

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

This soil is moderately well suited to local roads and streets. Low strength and the potential for frost action are limitations. Building the roads and streets on raised,

well compacted fill material, establishing adequate side ditches, and installing culverts reduce wetness and thus help to prevent the damage caused by frost action. The surface pavement and base material should be thick enough to compensate for the low strength of the soil.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability somewhat restricts the absorption of effluent in septic tank absorption fields. Enlarging the field, however, commonly overcomes this limitation. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed.

The capability subclass is IIe.

Go—Goessel silty clay. This deep, nearly level, moderately well drained soil occurs as broad, plane or slightly concave areas on uplands. Some of the lower areas are ponded for several days after heavy rainfall. Individual areas are irregular in shape and range from about 20 to more than 1,000 acres in size.

Typically, the surface layer is very dark gray silty clay about 7 inches thick. The subsurface layer is very dark gray, very firm silty clay about 7 inches thick. The next 36 inches is dominantly dark gray, mottled, very firm silty clay. The substratum to a depth of about 60 inches is gray, mottled silty clay.

Included with this soil in mapping are small areas of Farnum and Irwin soils, which make up about 10 percent of the unit. These soils are slightly higher on the landscape than the Goessel soil. Also, their surface layer is less clayey.

Permeability is very slow in the Goessel soil, and runoff is slow. Available water capacity is moderate. A perched seasonal high water table is at a depth of 2 to 3 feet. Organic matter content is moderate. The surface layer is very firm and cannot be easily tilled. It is slightly acid. The shrink-swell potential is high.

Most of the acreage is used for cultivated crops, but a few areas are used as range. This soil is moderately well suited to wheat and sorghum. Crops are adversely affected during dry periods because the clayey subsoil fails to release water readily to plants. Measures that improve tilth are needed. Keeping tillage at a minimum and leaving crop residue on the surface improve tilth and conserve moisture.

This soil is suited to range. The dominant native vegetation is big bluestem, little bluestem, and switchgrass. Overused areas are dominated by sideoats grama and blue grama. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

This soil is poorly suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements and low strength a limitation on sites for local roads and streets. Properly designing and

reinforcing foundations and backfilling with porous material help to prevent the damage to buildings caused by shrinking and swelling. Footing drains and sump pumps help to reduce the wetness. Roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

This soil is well suited to sewage lagoons. Because of the very slow permeability, however, it generally is unsuitable as a septic tank absorption field.

The capability subclass is IIs.

Ho—Hord silt loam. This deep, nearly level, well drained soil is on terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from about 100 to more than 600 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is friable silty clay loam about 30 inches thick. The upper part is dark grayish brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown silty clay loam. In a few areas the surface layer is calcareous.

Included with this soil in mapping are small areas of Crete soils, which make up about 10 percent of the unit. These soils are on uplands. Their subsoil is more clayey than that of the Hord soil.

Permeability is moderate in the Hord soil, and runoff is slow. Available water capacity is high. Organic matter content is moderate. Tilth is good. The surface layer is slightly acid.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to dryland and irrigated crops. Wheat, grain sorghum, and alfalfa are the chief dryland crops. Measures that conserve moisture are the main management needs. Minimizing tillage and leaving crop residue on the surface conserve moisture and maintain the fertility level.

Corn and grain sorghum are the chief irrigated crops. The main management needs are the efficient use of irrigation water and measures that maintain the level of fertility. Returning crop residue to the soil helps to maintain the content of organic matter and the level of fertility. Land leveling and water management improve water distribution.

This soil is poorly suited to dwellings and is moderately well suited to local roads and streets. The flooding is a hazard on sites for dwellings. Dikes, levees, or other flood control structures are needed. The higher parts of the landscape should be selected as building sites. Low strength is a limitation on sites for local roads and streets. The surface pavement and base material should be thick enough to compensate for the low

strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard in septic tank absorption fields. It can be controlled, however, by levees. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability class is I.

Ir—Irwin silty clay loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on uplands. Individual areas are irregular in shape and range from about 20 to more than 200 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsurface layer is very dark grayish brown, firm silty clay loam about 5 inches thick. The subsoil is about 31 inches thick. It is very firm. The upper part is dark grayish brown clay, the next part is grayish brown clay, and the lower part is light brownish gray silty clay. Shale bedrock is at a depth of about 42 inches.

Included with this soil in mapping are small areas of Goessel soils, which make up about 10 percent of the unit. These soils have a clayey surface layer. They are on the slightly lower parts of the landscape.

Permeability is very slow in the Irwin soil, and runoff is medium. Available water capacity is moderate. Organic matter content also is moderate. The surface layer is slightly acid. Tilth is fair. Root penetration is restricted by the shale at a depth of about 42 inches. The shrink-swell potential is high in the subsoil.

Most of the acreage is cultivated, but some areas are used as range. This soil is well suited to wheat and sorghum. Erosion is a hazard, however, if cultivated crops are grown. Terraces, grassed waterways, contour farming, a protective cover of crop residue, and minimum tillage help to control erosion, maintain the content of organic matter, and improve tilth.

This soil is suited to range. The dominant native vegetation is big bluestem, little bluestem, switchgrass, and indiagrass. If the range is overgrazed, these grasses are replaced by less productive grasses. Proper stocking rates and timely deferment of grazing help to keep the range in good condition.

The many areas where cropland is adjacent to rangeland can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these fringe areas provides winter cover for the wildlife.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling. Roads and streets should be designed so that

the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

Because of the very slow permeability, this soil generally is unsuitable as a septic tank absorption field. It is only moderately well suited to sewage lagoons because of the depth to bedrock and the slope. The deeper, nearly level included soils are well suited to lagoons.

The capability subclass is IIIe.

La—Ladysmith silty clay loam, 0 to 1 percent slopes. This deep, nearly level, somewhat poorly drained soil is on broad upland flats and ridgetops. Individual areas are irregular in shape and range from about 20 to more than 2,000 acres in size.

Typically, the surface layer is dark gray silty clay loam about 8 inches thick. The subsoil is mottled, very firm clay about 40 inches thick. The upper part is dark gray, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is light gray, mottled silty clay.

Included with this soil in mapping are scattered slick spots and small areas of soils that are underlain by sandy material at a depth of about 24 inches. Included areas make up about 15 percent of the unit. The soils that are underlain by sandy material are on narrow side slopes along small drainageways.

Permeability is very slow in the Ladysmith soil, and runoff is slow. Available water capacity is high. A perched seasonal high water table is at a depth of 2 to 3 feet. Organic matter content is moderate. Tilth is fair. The surface layer is medium acid. The clayey subsoil restricts root penetration. It has a high shrink-swell potential.

Nearly all of the acreage is used for cultivated crops. This soil is suited to dryland and irrigated crops. Wheat and grain sorghum are the chief dryland crops. The clayey subsoil restricts the movement of water into the soil and releases moisture slowly to plants. Minimizing tillage and leaving crop residue on the surface conserve moisture and increase the infiltration rate.

Corn and grain sorghum are the chief irrigated crops. The main management needs are the efficient use of irrigation water and measures that maintain the content of organic matter and the level of fertility. Returning crop residue to the soil is an example of these measures. Land leveling and water management improve water distribution.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations and backfilling with suitable coarse material help to prevent the damage caused by shrinking and swelling. Footing

drains and sump pumps reduce the wetness.

This soil is moderately well suited to local roads and streets. The shrink-swell potential and low strength are limitations. The surface pavement and base material should be thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the damage caused by shrinking and swelling.

This soil is well suited to sewage lagoons. Because of the very slow permeability, however, it generally is unsuitable as a septic tank absorption field.

The capability subclass is IIIs.

Ld—Ladysmith-Drummond complex. These deep, nearly level, somewhat poorly drained soils are on terraces. The Drummond soil generally is in slight depressions and is subject to rare flooding. Individual areas are irregular in shape and range from about 15 to more than 100 acres in size. They are about 65 percent Ladysmith soil and 35 percent Drummond soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Ladysmith soil has a surface layer of dark gray silty clay loam about 8 inches thick. The subsoil is mottled, very firm clay about 40 inches thick. The upper part is dark gray, and the lower part is light gray. The substratum to a depth of about 60 inches is light gray, mottled silty clay.

Typically, the Drummond soil has a surface layer of dark grayish brown loam about 7 inches thick. The subsoil is about 23 inches thick. It is very firm. The upper part is dark gray clay, and the lower part is brown clay loam. The substratum to a depth of about 60 inches is brown, mottled clay loam.

Permeability is very slow in both soils, and runoff is slow. Available water capacity is high in the Ladysmith soil and moderate in the Drummond soil. A seasonal high water table is at a depth of 2 to 3 feet in the Ladysmith soil and 2 to 6 feet in the Drummond soil. Organic matter content is moderate in the Ladysmith soil and moderately low in the Drummond soil. The Drummond soil is slightly affected by soluble salts and contains excess sodium. It is in poor tilth. The surface layer of both soils is slightly acid. The shrink-swell potential is high in the subsoil.

About half of the acreage is used for cultivated crops, mainly wheat and sorghum. The rest generally is used as range. This unit is poorly suited to cultivated crops because of the low fertility and excess salts and sodium in the Drummond soil. Leaving crop residue on the surface and minimizing tillage help to prevent surface crusting, improve tilth, conserve moisture, and increase the content of organic matter.

These soils are suited to range. In most of the areas used as range, the dominant native vegetation is big bluestem, little bluestem, indiagrass, and switchgrass. In the more saline-alkali areas, however, it is prairie

cordgrass, switchgrass, and inland saltgrass. Overused areas are dominated by inland saltgrass, sideoats grama, and blue grama. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

The Drummond soil generally is unsuited to building site development and sanitary facilities because of the flooding and the wetness. Because of the flooding, only the higher parts of the landscape should be selected as sites for dwellings.

The Ladysmith soil is poorly suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, the wetness is a limitation on sites for dwellings with basements and low strength a limitation on sites for local roads and streets. Properly designing and reinforcing foundations and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling. Footing drains and sump pumps reduce the wetness. Roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

The Ladysmith soil is well suited to sewage lagoons. Because of the very slow permeability, however, it generally is unsuitable as a septic tank absorption field.

The capability subclass is IVs.

Le—Lancaster loam, 2 to 6 percent slopes. This moderately deep, moderately sloping, well drained soil is on the broad tops and sides of upland ridges. Individual areas are irregular in shape and range from about 50 to several hundred acres in size.

Typically, the surface layer is brown loam about 10 inches thick. The subsoil is about 22 inches thick. The upper part is brown, friable clay loam; the next part is reddish brown, firm clay loam; and the lower part is reddish yellow, mottled, firm sandy clay loam. Sandy shale and sandstone bedrock is at a depth of about 32 inches. In a few areas sandstone fragments are on the surface. In some areas the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of Edalgo soils on side slopes. These soils make up about 10 percent of the unit. Their subsoil is more clayey than that of the Lancaster soil.

Permeability is moderate in the Lancaster soil, and runoff is medium. Available water capacity is low. Organic matter content is moderate. The surface layer is friable and can be easily tilled. It typically is medium acid. Root penetration is restricted by the sandy shale and sandstone at a depth of about 32 inches. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used as range, but some areas are used for cultivated crops. This soil is moderately well suited to wheat, sorghum, and alfalfa. Erosion is a

hazard if cultivated crops are grown. Terraces, grassed waterways, contour farming, and minimum tillage help to prevent excessive soil loss.

This soil is suited to range. The dominant native vegetation is big bluestem, little bluestem, indiagrass, and switchgrass. Overused areas are dominated by blue grama, buffalograss, and sideoats grama. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Also, the depth to bedrock is a limitation on sites for dwellings with basements. The rock generally is soft, however, and can be easily excavated. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the damage caused by shrinking and swelling.

This soil is moderately well suited to local roads and streets. Low strength and the potential for frost action are limitations. Building the roads and streets on raised, well compacted fill material, establishing adequate side ditches, and installing culverts reduce wetness and thus help to prevent the damage caused by frost action. The surface pavement and base material should be thick enough to compensate for the low strength of the soil.

Because of the depth to bedrock, this soil is poorly suited to septic tank absorption fields and sewage lagoons. The areas on the lower side slopes where the depth to bedrock is more than 40 inches are suitable sites for sewage disposal systems.

The capability subclass is IVe.

Lh—Lancaster-Hedville loams, 6 to 12 percent slopes. These strongly sloping soils are on uplands dissected by deeply entrenched drainageways. The moderately deep, well drained Lancaster soil is on the less sloping tops and sides of ridges. The shallow, somewhat excessively drained Hedville soil is on the steeper upper sides and narrow tops of the ridges. Individual areas are irregular in shape and range from 50 to several hundred acres in size. They are about 50 percent Lancaster soil and 30 percent Hedville soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Lancaster soil has a surface layer of brown loam about 10 inches thick. The subsoil is about 22 inches thick. The upper part is brown, friable clay loam; the next part is reddish brown, firm clay loam; and the lower part is reddish yellow, firm sandy clay loam. Sandy shale or sandstone bedrock is at a depth of about 32 inches. In a few areas the depth to bedrock is more than 40 inches.

Typically, the Hedville soil has a surface layer of dark grayish brown loam about 11 inches thick. The subsurface layer is brown, friable loam about 4 inches

thick. Sandstone bedrock is at a depth of about 15 inches.

Included with these soils in mapping are small areas of Edalgo soils and rock outcrop. These included areas make up about 20 percent of the unit. Edalgo soils have a subsoil of silty clay loam or silty clay. They are on side slopes. The rock outcrop is on the upper sides and narrow tops of the ridges.

Permeability is moderate in the Lancaster and Hedville soils, and runoff is medium or rapid. Available water capacity is very low in the Hedville soil and low in the Lancaster soil. Organic matter content is moderate in both soils. Root penetration is restricted by the sandy shale or sandstone bedrock at a depth of about 32 inches in the Lancaster soil and about 15 inches in the Hedville soil. The shrink-swell potential is moderate in the subsoil of the Lancaster soil.

Nearly all areas are used as range. Because the hazard of erosion is severe, these soils generally are unsuitable for cultivation. They are best suited to range. The native vegetation dominantly is big bluestem, little bluestem, indiagrass, and switchgrass. Overgrazed areas are dominated by less productive grasses, such as blue grama, sideoats grama, and buffalograss. Proper stocking rates and timely deferment of grazing help to prevent deterioration of the more desirable grasses. Well distributed salting and watering facilities help to obtain a uniform distribution of grazing.

The Hedville soil generally is unsuited to building site development and sanitary facilities because it is shallow over bedrock.

The Lancaster soil is moderately well suited to dwellings. The slope and the shrink-swell potential are limitations. Also, the depth to bedrock is a limitation on sites for dwellings with basements. The rock generally is soft, however, and can be easily excavated. Because of the slope, some land shaping commonly is needed. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the damage caused by shrinking and swelling.

The Lancaster soil is moderately well suited to local roads and streets. Low strength, the slope, and the potential for frost action are limitations. Building the roads and streets on raised, well compacted fill material, establishing adequate side ditches, and installing culverts reduce wetness and thus help to prevent the damage caused by frost action. The surface pavement and base material should be thick enough to compensate for the low strength of the soil. Because of the slope, some land shaping commonly is needed.

Because of the depth to bedrock, the Lancaster soil is poorly suited to septic tank absorption fields and sewage lagoons. The deeper, less sloping soils on the lower side slopes are well suited to onsite sewage disposal systems.

The capability subclass is VIe.

Ln—Longford silty clay loam, 3 to 6 percent slopes. This deep, moderately sloping, well drained soil is on the tops and sides of upland ridges. Individual areas are irregular in shape and range from about 20 to more than 200 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 10 inches thick. The subsoil is about 37 inches thick. The upper part is reddish brown, firm silty clay loam; the next part is reddish brown, very firm silty clay; and the lower part is brown, very firm silty clay. The substratum to a depth of about 60 inches is brown, mottled silty clay loam. In a few areas the subsoil is calcareous.

Included with this soil in mapping are small areas of the moderately deep Edalgo and Lancaster soils on the steeper side slopes. These soils make up about 15 percent of the unit.

Permeability is slow in the Longford soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate. Tilth is fair. The surface layer is medium acid. The shrink-swell potential is high in the subsoil.

Most of the acreage is cultivated. This soil is moderately well suited to wheat, sorghum, and alfalfa. If cultivated crops are grown, erosion is a hazard. Terraces, grassed waterways, contour farming, a protective cover of crop residue, and minimum tillage help to control erosion, maintain the content of organic matter, and improve tilth.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling. Roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field or installing the distribution lines below the clayey subsoil, however, helps to overcome this limitation. The slope is a limitation on sites for sewage lagoons. Some land shaping commonly is needed.

The capability subclass is IIIe.

Lo—Longford silty clay loam, 2 to 6 percent slopes, eroded. This deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 5 to 50 acres in size.

Typically, the surface layer is brown silty clay loam about 6 inches thick. Plowing has mixed the original surface layer with the upper part of the subsoil. The subsoil is very firm silty clay about 30 inches thick. The upper part is reddish brown, and the lower part is brown. The substratum to a depth of about 60 inches is brown silty clay loam. In a few areas the surface layer is calcareous.

Included with this soil in mapping are small areas of the moderately deep Edalgo and Lancaster soils on the steeper side slopes. These soils make up about 10 to 15 percent of the unit.

Permeability is slow in the Longford soil, and runoff is medium. Available water capacity is high. Organic matter content is moderately low. Tilth is poor. The surface layer is medium acid. The shrink-swell potential is high in the subsoil.

Most areas are used for cultivated crops, but some are abandoned cropland or are used as range. This soil is moderately well suited to wheat and grain sorghum. If cultivated crops are grown, further erosion is a hazard. Terraces, grassed waterways, contour farming, and a protective cover of crop residue help to prevent excessive soil loss, conserve moisture, and improve tilth.

This soil is suited to range. A cover of grasses is effective in controlling erosion. Abandoned cropland should be reseeded to native grasses. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling. Roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. Enlarging the field or installing the distribution lines below the clayey subsoil, however, helps to overcome this limitation. The slope is a limitation on sites for sewage lagoons. Some land shaping commonly is needed.

The capability subclass is IIIe.

Mc—McCook fine sandy loam. This deep, nearly level, well drained soil is on terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from about 10 to 150 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 6 inches thick. The subsurface layer is grayish brown, very friable fine sandy loam about 8 inches thick. The next 14 inches is light brownish gray, very friable very fine sandy loam. The substratum to a depth of about 60 inches is pale brown very fine sandy loam. The soil is calcareous throughout. In a few areas a subsoil of silty clay loam underlies the surface soil.

Included with this soil in mapping are strongly sloping soils on terrace breaks. These soils make up less than 5 percent of the unit.

Permeability is moderate in the McCook soil, and runoff is slow. Available water capacity is high. Organic matter content is moderately low. Tilth is good. The surface layer is mildly alkaline or moderately alkaline.

Nearly all areas are used for cultivated crops. This soil is well suited to dryland and irrigated crops. Wheat, grain sorghum, and alfalfa are the chief dryland crops. Controlling soil blowing and conserving moisture are the main concerns of management. Stripcropping, minimizing tillage, and leaving crop residue on the surface help to control soil blowing, conserve moisture, maintain the level of fertility, and prevent deterioration of tilth.

Corn and grain sorghum are the chief irrigated crops. The main management needs are the efficient use of irrigation water and measures that help to control soil blowing and maintain the content of organic matter and the level of fertility. Leaving crop residue on the surface is an example of these measures. Land leveling and water management improve water distribution.

This soil is poorly suited to dwellings and is moderately well suited to local roads and streets. The flooding is a hazard. Also, the potential for frost action is a limitation on sites for local roads and streets. Dikes, levees, and other flood control structures help to keep floodwater away from dwellings. The higher parts of the landscape should be selected as building sites. Building roads and streets on raised, well compacted fill material, establishing adequate side ditches, and installing culverts help to prevent the road damage caused by flooding and frost action.

This soil is moderately well suited to septic tank absorption fields and is poorly suited to sewage lagoons. The flooding is a hazard. Also, seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon. Levees help to control floodwater.

The capability subclass is IIe.

Ns—Ness silty clay. This deep, nearly level, poorly drained soil is in depressions in the uplands. It is frequently ponded during the spring and fall (fig. 10). Individual areas are circular or oblong and range from about 10 to 150 acres in size.

Typically, the surface layer is dark gray silty clay about 12 inches thick. The subsurface layer is very dark gray, mottled, very firm silty clay about 12 inches thick. The



Figure 10.—A ponded area of Ness silty clay.

substratum to a depth of about 60 inches is gray, mottled silty clay.

Included with this soil in mapping are small areas of the moderately well drained Crete and somewhat poorly drained Ladysmith soils on the slightly higher flats and side slopes. These soils make up about 10 percent of the unit.

Permeability is very slow in the Ness soil, and runoff is ponded. A perched seasonal high water table is near or above the surface. Available water capacity is moderate. Organic matter content also is moderate. The surface layer is very firm and cannot be easily tilled. It is slightly acid. The shrink-swell potential is high.

Most areas are ponded, bare, or sparsely covered with weeds and western wheatgrass. Some are cultivated along with the better drained adjacent soils. Sorghum is the chief crop in these drier areas. Because of the ponding, this soil generally is unsuitable as cropland and is not well suited to range. The native plants and amount of forage vary from area to area.

The ponding on this soil results in shallow water areas that can be used as habitat by waterfowl and other kinds of wildlife. The adjacent soils generally are used for cultivated crops, which supply food and nesting areas.

This soil generally is unsuited to building site development and sanitary facilities because of the

ponding.

The capability subclass is VIw.

Nw—New Cambria silty clay. This deep, nearly level, moderately well drained soil is on terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from about 40 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown silty clay about 6 inches thick. The subsurface layer is very dark grayish brown, very firm silty clay about 6 inches thick. The subsoil is dark grayish brown, very firm silty clay about 13 inches thick. The underlying material to a depth of about 60 inches is clay. It is very dark gray in the upper part and dark grayish brown in the lower part.

Included with this soil in mapping are small areas of the silty Hord and Roxbury soils on the slightly higher parts of the landscape. These soils make up about 10 percent of the unit.

Permeability is slow in the New Cambria soil. Runoff also is slow. Available water capacity is high. Organic matter content is moderate. The surface layer is firm and cannot be easily tilled. It is mildly alkaline.

Most of the acreage is cultivated. This soil is moderately well suited to wheat and sorghum. Planting and tillage are delayed during some wet periods. Drainage ditches help to remove excess surface water. Minimizing tillage and returning crop residue to the soil

improve tillage and increase the rate of water infiltration.

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

The capability subclass is IIw.

Pa—Plevna fine sandy loam. This deep, nearly level, poorly drained soil is in depressions on sandhills. It is frequently flooded. Individual areas range from about 15 to more than 100 acres in size.

Typically, the surface layer is dark gray fine sandy loam about 9 inches thick. The subsurface layer is dark grayish brown, friable fine sandy loam about 9 inches thick. The subsoil is grayish brown, mottled, friable fine sandy loam about 18 inches thick. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand.

Included with this soil in mapping are small areas of Carwile soils, which make up about 15 percent of the unit. These soils are higher on the landscape than the Plevna soil. Also, their subsoil is more clayey.

Permeability is moderately rapid in the Plevna soil, and runoff is very slow. Available water capacity is moderate. The water table is at a depth of 2 or 3 feet during much of the growing season and is within a few inches of the surface during some wet periods. Organic matter content is moderate.

Nearly all of the acreage is used as range. This soil generally is unsuited to cultivated crops because of the wetness. It is better suited to range. The dominant native vegetation is big bluestem, indiangrass, prairie cordgrass, switchgrass, and eastern gamagrass. In overgrazed areas these grasses are replaced by less productive grasses. Proper stocking rates and timely deferment of grazing help to keep the range in good condition. The turf can be damaged if the livestock graze when the water table is near the surface.

This soil generally is unsuited to building site development and sanitary facilities because of the flooding and the wetness. Overcoming the flooding is difficult without major flood control measures.

The capability subclass is Vw.

Pr—Pratt loamy fine sand, rolling. This deep, rolling, well drained soil is on uplands. Individual areas are irregular in shape and range from about 10 to 60 acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 11 inches thick. The subsoil is brown, very friable loamy fine sand about 25 inches thick. The substratum to a depth of about 60 inches is brown loamy fine sand. In some areas the subsoil is fine sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Carwile and poorly drained Plevna soils in depressions or on flats. These soils make up about 15 percent of the unit.

Permeability is rapid in the Pratt soil, and runoff is slow. Available water capacity is low. Organic matter content also is low. The surface layer is slightly acid.

Nearly all of the acreage is used as range. This soil is poorly suited to cultivated crops because of the hazard of soil blowing. It is suited to range. A grass cover is effective in controlling soil blowing. The dominant native grasses are sand bluestem, little bluestem, indiangrass, and sand lovegrass. In overgrazed areas the more productive grasses are replaced by blue grama and other less productive grasses. Proper stocking rates and timely deferment of grazing help to keep the range in good condition.

This soil is moderately well suited to dwellings and local roads and streets. Because of the slope, some land shaping commonly is needed on sites for dwellings and cutting and filling may be needed on sites for roads. Because of the hazard of soil blowing, road cuts should be seeded to suitable grasses (fig. 11). Mulching with straw or hay helps to control soil blowing until the grass is established.

Because of seepage, this soil generally is unsuitable as a site for sewage lagoons. It is poorly suited to septic tank absorption fields because the sandy substratum does not adequately filter the effluent. The poor filtering capacity may result in the pollution of shallow ground water. The areas where the subsoil is fine sandy loam are better sites for sanitary facilities.

The capability subclass is IVe.

Ro—Roxbury silty clay loam. This deep, nearly level, well drained soil is on terraces along the major streams. It is subject to rare flooding. Individual areas are long and narrow and range from about 50 to 500 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 13 inches thick. The subsoil is grayish brown, friable silty clay loam about 15 inches thick. The upper part of the substratum is light brownish gray silty clay loam. The lower part to a depth of about 60 inches is very pale brown silt loam. The soil is calcareous throughout. In a few areas the surface layer is fine sandy loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. Organic matter content is moderate. Tillage is good. The surface layer is mildly alkaline. The shrink-swell potential is moderate.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to dryland and irrigated crops. Wheat, sorghum, and alfalfa are the chief dryland crops. The main concern of management is conserving moisture. Minimizing tillage and leaving crop residue on the surface conserve moisture and help to maintain the level of fertility and the content of organic matter of the soil.

Corn and grain sorghum are the chief irrigated crops. The main management needs are the efficient use of irrigation water and measures that maintain the level of fertility and help to prevent deterioration of tillage. Leaving crop residue on the surface is an example of these measures. Land leveling and water management improve



Figure 11.—A road in an area of Pratt loamy fine sand, rolling, which is susceptible to soil blowing if the surface is bare.

water distribution.

This soil is poorly suited to dwellings and is moderately well suited to local roads and streets. The flooding is a hazard on sites for dwellings. Dikes, levees, and other flood control structures are needed. The higher parts of the landscape should be selected as building sites. Low strength is a limitation on sites for local roads and streets. The surface pavement and base material should be thick enough to compensate for the low strength of the soil. Providing coarser grained base material for roads helps to ensure better performance.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard in septic tank absorption fields. It can be controlled, however, by levees. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability class is I.

Sm—Smolan silty clay loam, 1 to 3 percent slopes.

This deep, gently sloping, moderately well drained soil is on the tops and sides of upland ridges. Areas are irregular in shape and about 20 to more than 100 acres.

Typically, the surface layer is brown silty clay loam about 11 inches thick. The subsoil is silty clay about 36 inches thick. The upper part is dark reddish gray and firm, the next part is dark reddish gray and very firm, and the lower part is reddish brown and very firm. The substratum to a depth of about 60 inches is reddish brown silty clay.

Included with this soil in mapping are small areas of Wells and Edalgo soils, which make up about 10 percent of the unit. The loamy Wells soils are on the lower side slopes. The moderately deep Edalgo soils are on the steeper side slopes.

Permeability is slow in the Smolan soil, and runoff is medium. Available water capacity is high. Organic matter content is moderate. Tilth is good. The surface layer is

medium acid. The shrink-swell potential is high in the subsoil.

Most areas are used for cultivated crops. Only a few small areas are used as range. This soil is well suited to wheat and sorghum. Erosion is a hazard, however, if cultivated crops are grown. Also, the clayey subsoil restricts the movement of water into the soil and releases moisture slowly to plants. Minimizing tillage and returning crop residue to the soil conserve moisture. Terraces and contour farming reduce the runoff rate and help to prevent excessive soil loss.

This soil is moderately well suited to dwellings and local roads and streets. The shrink-swell potential is a limitation. Also, low strength is a limitation on sites for local roads and streets. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the damage to buildings caused by shrinking and swelling. Roads and streets should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to prevent the road damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields because the slow permeability restricts the absorption of the effluent. Enlarging the field, however, helps to overcome this limitation. The soil is well suited to sewage lagoons. Because of the slope, however, some land shaping commonly is needed.

The capability subclass is IIe.

To—Tobin silt loam, occasionally flooded. This deep, nearly level, moderately well drained soil is on flood plains along small creeks and drainageways. It is occasionally flooded for very brief periods. Individual areas are long and narrow and range from about 80 to more than 300 acres in size.

Typically, the surface soil is very dark grayish brown silt loam about 24 inches thick. The substratum to a depth of about 60 inches is dark grayish brown and grayish brown silt loam. It is mottled in the lower part. In a few areas the surface soil is calcareous.

Permeability is moderate, and runoff is slow. Available water capacity is high. Organic matter content is moderate. Tilth is good. The surface soil is slightly acid or neutral. The shrink-swell potential is moderate.

Most of the acreage is used for cultivated crops. The rest is used as range. This soil is well suited to corn and sorghum and is moderately well suited to wheat and alfalfa. Yields are reduced in some years because of the flooding, but in other years they may be increased by the extra moisture. Dikes and diversions help to prevent the crop damage caused by floodwater.

This soil is suited to range. Many areas are overgrazed. In these areas, the range is in poor condition and the more desirable grasses are replaced by less productive grasses and by weeds. In areas

where the range is in good condition, the dominant native vegetation is big bluestem, indiangrass, and switchgrass. Livestock tend to congregate in areas near shade trees and watering facilities. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help to keep the range in good condition. Placing salt blocks on the steeper adjacent soils helps to achieve a uniform distribution of grazing.

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

The capability subclass is IIw.

Wb—Wells loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on the tops and sides of upland ridges. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

Typically, the surface layer is brown loam about 11 inches thick. The subsoil is reddish brown, firm sandy clay loam about 38 inches thick. The substratum to a depth of about 60 inches is reddish yellow sandy loam. In most areas the subsoil or substratum contains coarse pebbles and sand grains (fig. 12).

Included with this soil in mapping are small areas of Smolan soils on ridgetops. These soils make up about 10 percent of the unit. Their subsoil is more clayey than that of the Wells soil.

Permeability is moderate in the Wells soil, and runoff is medium. Available water capacity is high. Organic matter content is moderately low. Tilth is good. The surface layer is medium acid. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used for cultivated crops. This soil is well suited to wheat, sorghum, and alfalfa. Erosion is a hazard, however, if cultivated crops are grown. Terraces, grassed waterways, contour farming, a protective cover of crop residue, and minimum tillage help to control erosion, maintain the content of organic matter, and prevent deterioration of tilth.

This soil is well suited to dwellings and is moderately well suited to local roads and streets. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations and footings, however, helps to prevent the damage to buildings caused by shrinking and swelling. Low strength is a limitation on sites for local roads and streets. The surface pavement and base material should be thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is well suited to septic tank absorption fields and is moderately well suited to sewage lagoons. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. If the less sloping areas are selected as sites for the

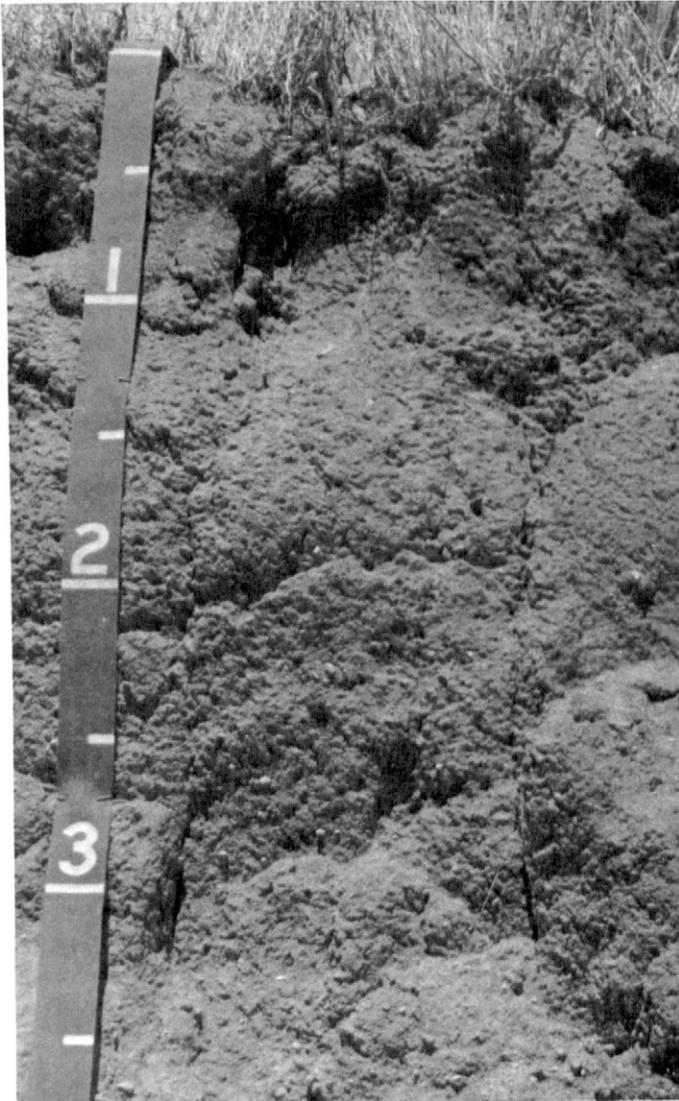


Figure 12.—Typical profile of Wells loam, 1 to 3 percent slopes. Pebbles are, common, in the subsoil. Depth is marked in feet.

lagoons, less leveling and banking will be needed during construction.

The capability subclass is IIe.

Wc—Wells loam, 3 to 6 percent slopes. This deep, moderately sloping, well drained soil is on uplands. Individual areas are irregular in shape and range from about 20 to 150 acres in size.

Typically, the surface layer is brown loam about 11 inches thick. The subsoil is reddish brown, firm sandy clay loam about 38 inches thick. The substratum to a depth of about 60 inches is reddish yellow sandy loam. In most areas it contains pebbles and coarse sand grains. In a few areas the subsoil is silty clay loam.

Permeability is moderate, and runoff is medium. Available water capacity is high. Organic matter content is moderately low. The surface layer is friable and can be easily tilled. It typically is medium acid. The subsoil is slightly acid. It has a moderate shrink-swell potential.

About half of the acreage is used for cultivated crops, and half is used as range. This soil is moderately well suited to wheat, sorghum, and alfalfa. Measures that help to control erosion are the main management needs. Examples are terraces, grassed waterways, contour farming, and minimum tillage. Leaving crop residue on the surface reduces the runoff rate, increases the rate of water infiltration, helps to maintain the content of organic matter, and helps to prevent deterioration of tilth.

This soil is suited to range. The dominant native vegetation is big bluestem, little bluestem, indiangrass, and switchgrass. In overused areas the more productive grasses are replaced by sideoats grama, tall dropseed, and blue grama. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is well suited to dwellings and is moderately well suited to local roads and streets. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations and footings, however, helps to prevent the damage to buildings caused by shrinking and swelling. Low strength is a limitation on sites for local roads and streets. The surface pavement and base material should be thick enough to compensate for the low strength of the soil. Providing coarser grained base material helps to ensure better performance.

This soil is well suited to septic tank absorption fields and is moderately well suited to sewage lagoons. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. If the less sloping areas are selected as sites for the lagoons, less leveling and banking will be needed during construction.

The capability subclass is IIIe.

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 providing the Nation's short-range 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 cropland, pasture, woodland, or other land but is not urban or built-up land or water areas. It either is used for food or fiber or is available for those uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. 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 usually 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 local offices of the Soil Conservation Service.

About 474,000 acres in McPherson County, or 83 percent of the total acreage, meets the requirements for prime farmland. Nearly all the acreage in the Crete-Smolan, Ladysmith-Goessel, Longford-Clime-Irwin, and Hord-Tobin-Bridgeport associations, which are described under the heading "General soil map units," is prime farmland. About 35 percent of the Lancaster-Hedville-Edalgo association is prime farmland. Most of the prime farmland is cropland, some of which is irrigated.

The map units in McPherson County 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:

At	Attica loamy fine sand, 1 to 4 percent slopes
Br	Bridgeport silt loam
Cb	Cass fine sandy loam
Ce	Clime silty clay, 1 to 3 percent slopes
Cr	Crete silt loam, 0 to 1 percent slopes
Cs	Crete silt loam, 1 to 3 percent slopes
Ct	Crete silty clay loam, 1 to 3 percent slopes, eroded
De	Detroit silty clay loam
Fa	Farnum loam, 1 to 3 percent slopes
Ge	Geary silt loam, 1 to 3 percent slopes
Go	Goessel silty clay
Ho	Hord silt loam
Ir	Irwin silty clay loam, 1 to 3 percent slopes
La	Ladysmith silty clay loam, 0 to 1 percent slopes
Le	Lancaster loam, 2 to 6 percent slopes
Ln	Longford silty clay loam, 3 to 6 percent slopes
Lo	Longford silty clay loam, 2 to 6 percent slopes, eroded
Mc	McCook fine sandy loam
Nw	New Cambria silty clay
Ro	Roxbury silty clay loam
Sm	Smolan silty clay loam, 1 to 3 percent slopes
To	Tobin silt loam, occasionally flooded
Wb	Wells loam, 1 to 3 percent slopes
Wc	Wells 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, and trees and shrubs.

crops and pasture

Earl J. Bondy, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants 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 the arable soils.

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 74 percent of the acreage in McPherson County is used for cultivated crops. During the period 1967 to 1977, wheat was grown on about 57 percent of the cropland, sorghum on 23 percent, and alfalfa, corn, soybeans, barley, and oats on 11 percent. The remaining 9 percent was summer fallowed (3). The acreage planted to sorghum has increased in recent years, whereas that planted to all other crops has decreased or remained constant. About 25,000 acres is irrigated. Most of the acreage used for corn is irrigated.

The main management needs in the areas used for cultivated crops are measures that help to control erosion and soil blowing, improve fertility and tilth, and increase the content of organic matter.

Soil erosion is the major hazard on about 42 percent of the cropland in the county. It reduces the productivity of the soil and results in the pollution of streams by sediments, nutrients, and pesticides. If the surface layer is lost through erosion, most of the available plant nutrients and organic matter, which has positive effects on soil structure, water infiltration, available water capacity, and tilth, also are lost. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Crete, Irwin, and Smolan soils. Preparing a good seedbed and tilling are difficult in the clayey spots that remain after the original friable surface layer has eroded away. Control of erosion not only helps to maintain the productivity of the soil but also helps to maintain the quality of water by minimizing the pollution of streams.

Measures that control erosion provide a protective cover of crops or crop residue, reduce the runoff rate, and increase the rate of water infiltration. An example is a cropping system that keeps a protective plant cover on the surface for extended periods. Other examples are minimum tillage, terraces, diversions, contour farming, and a cropping system that includes close growing crops as well as row crops. In the areas of the county used for sorghum and other row crops, minimum tillage is helping

to control erosion on an increasing acreage. It is effective on most of the soils in the county. Terraces and diversions help to control runoff and erosion by reducing the length of slopes. They are most effective on deep, well drained soils that have uniform, regular slopes. Most of the soils in the county have those characteristics.

Further information about erosion control on each kind of soil is available at local offices of the Soil Conservation Service.

Soil blowing is a hazard on Attica, Pratt, and other sandy soils. It can be controlled by a protective cover of plants, crop residue, or mulch; wind stripcropping; windbreaks; or tillage methods that roughen the surface.

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

Organic matter provides nitrogen for crops, increases the water intake rate, helps to prevent surface crusting and deterioration of tilth, and helps to control erosion. Most of the cultivated soils in the county have a surface layer of silty clay loam, silt loam, or loam. A surface crust forms during periods of intense rainfall. Because it is hard when dry and is nearly impervious to water, the crusted surface increases the runoff rate. Regularly adding organic material or leaving crop residue on the surface improves soil structure and helps to prevent surface crusting.

The chief tame grass grown in McPherson County is smooth bromegrass. The main management needs in the areas of tame grass are measures that maintain or improve the quality and quantity of forage, help to control erosion, and reduce water loss. Examples are proper stocking rates, rotation grazing, well distributed watering and salting facilities, applications of fertilizer, and control of unwanted vegetation.

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 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 insures 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 listed 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.

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 grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider 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 slight 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, 11e. 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."

rangeland

Lynn Gibson, range conservationist, Soil Conservation Service, helped prepare this section.

About 120,000 acres in McPherson County, or 22 percent of the total acreage, is rangeland. About 40 percent of the farm income in the county is derived from the sale of livestock, principally cattle.

Most of the livestock enterprises are stock farms. Many of those in the northern part of the county, however, are ranches. In this part of the county, rangeland is the principal land use and the soils are shallow or moderately deep and formed in material weathered from sandstone and shale. Farm ponds are the main source of water for the livestock in this area (fig. 13).

Some farmers and ranchers extend the grazing season by supplemental grazing of cool-season tame pasture grasses, principally brome grass. Many also supplement the grassland forage with crop residue, some wheat pasture, and, during most winters, hay and protein concentrates.

Because of the soil characteristics and the amount of precipitation, the soils in the county can support a mixed plant community dominated by the taller grasses, such as bluestem (*Andropogon*), switchgrass (*Panicum virgatum*), and indiagrass (*Sorghastrum nutans*). Sandy

soils strongly influence a small area of interspersed cropland and rangeland in the southwest corner of the county. The potential natural plant community in this area is dominated by bluestem, indiagrass, sandreed (*Calamovilfa*), and other tall grasses.

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 soils in the survey area, 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 or are suited to 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 reduced to a common percent of air-dry moisture.

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



Figure 13.—A stock water pond in an area of Edalgo silt loam, 5 to 12 percent slopes, used as range. An area of Lancaster-Hedville loams, 6 to 12 percent slopes, is used as range in the background.

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 and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Controlled grazing is one of the major management needs on the rangeland in McPherson County. It helps to establish or maintain the natural plant community.

Forage production has been reduced in many areas because the natural plant community has been depleted by overgrazing. Proper stocking rates and a uniform distribution of grazing help to keep the range in good condition. In combination with timely deferment of grazing, reseeding of abandoned cropland, and brush control, these measures also improve the range that is in poor condition.

woodland, windbreaks, and environmental plantings

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

The chief wooded areas in McPherson County are along the streams and the upland drainageways (fig. 14). Other wooded areas are the remains of some timber claim plantings throughout the county and some commercial orchards in the southeast corner. Apples, peaches, and pears are the main fruits grown in the commercial orchards.

The trees along streams and drainageways are mainly eastern cottonwood, green ash, black willow, hackberry, Russian mulberry, boxelder, black walnut, American elm, red elm, osageorange, and American plum. Many of these trees, especially black walnut, eastern cottonwood, and green ash, can be used for commercial wood products or firewood. These areas are not managed for commercial wood production, however, because the trees are not concentrated in large tracts.

Landowners have established windbreaks and environmental plantings on most of the farmsteads in the county. Siberian elm and eastern redcedar are the most common trees on the farmsteads, especially on the older ones. Green ash, honeylocust, hackberry, Scotch pine, silver maple, black locust, bur oak, and other species also have been planted.

Tree planting on farmsteads is a continual need because old trees deteriorate and die, because insects, diseases, and storms destroy some trees, and because new windbreaks are needed in areas where farming or ranching is expanding.

Field windbreaks or shelterbelts are common in the

county. Also, many hedgerows of osageorange line farm and field boundaries. Most of the shelterbelts are eight to ten rows of trees and shrubs planted in various combinations and arrangements. The main species are eastern redcedar, Russian-olive, ponderosa pine, black walnut, bur oak, hackberry, green ash, honeylocust, Siberian elm, osageorange, tamarisk, Kentucky coffeetree, Russian mulberry, Rocky Mountain juniper, eastern cottonwood, skunkbush sumac, American plum, northern catalpa, and American elm.

In order for windbreaks or environmental plantings to fulfill their intended purpose, the soils on the site should be suited to the trees or shrubs selected for planting. Selecting suitable species helps to ensure survival and a maximum growth rate. The growth rate is significantly affected by the permeability, available water capacity, and fertility of the soil.

Trees and shrubs can be easily established on most of the soils in the county. Competition from weeds and grasses is the main problem. It can be controlled, however, by proper site preparation before the trees or shrubs are planted and by measures that remove the

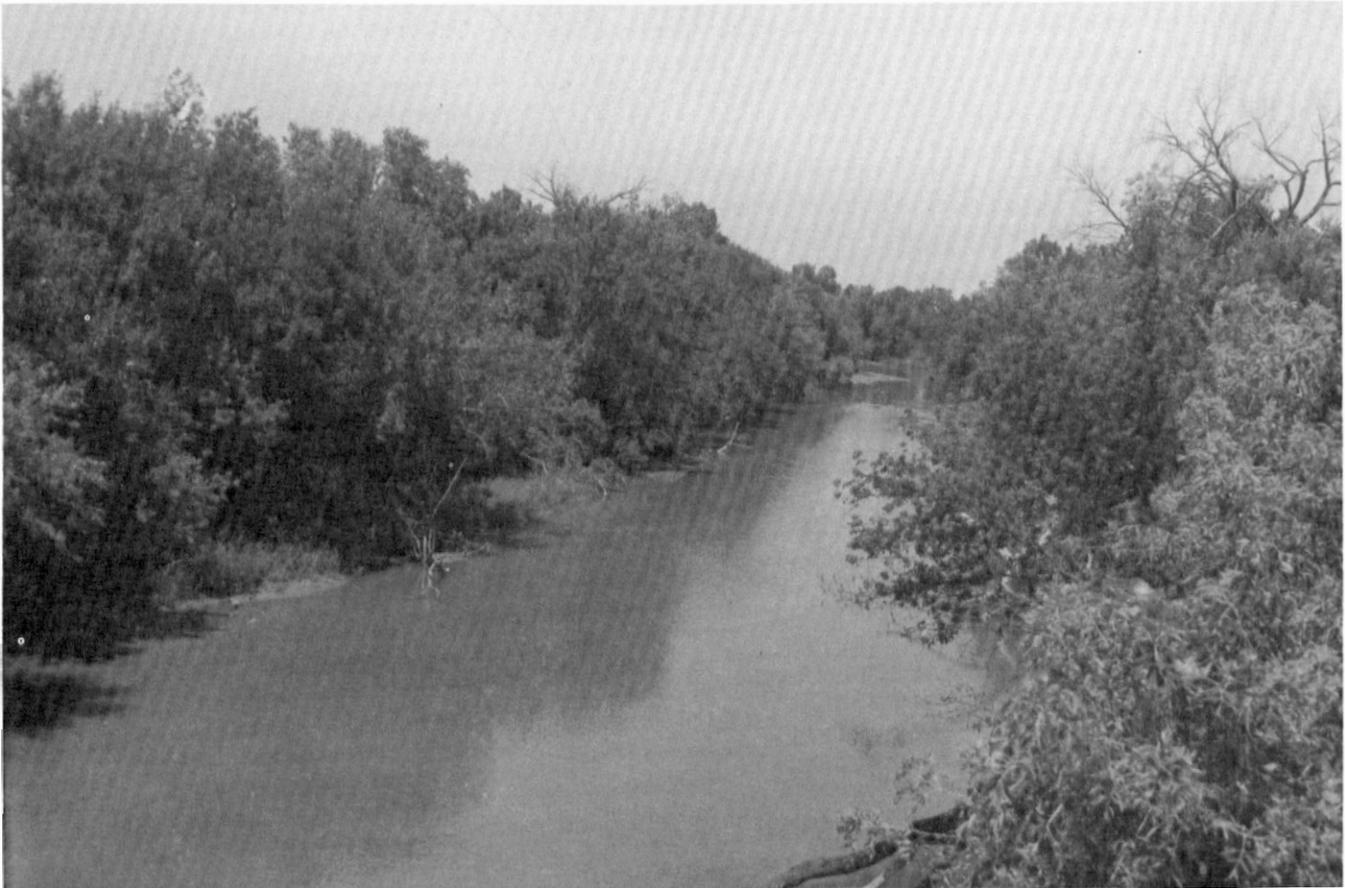


Figure 14.—A typical wooded area adjacent to the Smoky Hill River.

competing plants after the windbreaks or environmental plantings are established.

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, keep snow from blowing off 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 insure 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 nursery.

recreation

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

McPherson County has several areas of scenic, geologic, and historic interest. Farm ponds, the Little Arkansas River, and the Smoky Hill River provide opportunities for water sports. The McPherson State Fishing Lake and Lake Inman are recreation areas open to the public. The Maxwell Game Refuge, which is in the northeastern part of the county, provides many visitors the opportunity to observe buffalo and elk (fig. 15). It is owned by the state and operated by the Kansas Fish and Game Commission. A few private recreation areas have been developed for families and other groups. The potential for further recreational development is fair.

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 or the

suitability for sewage lagoons 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.

Paths and trails for hiking, horseback riding, and bicycling 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.

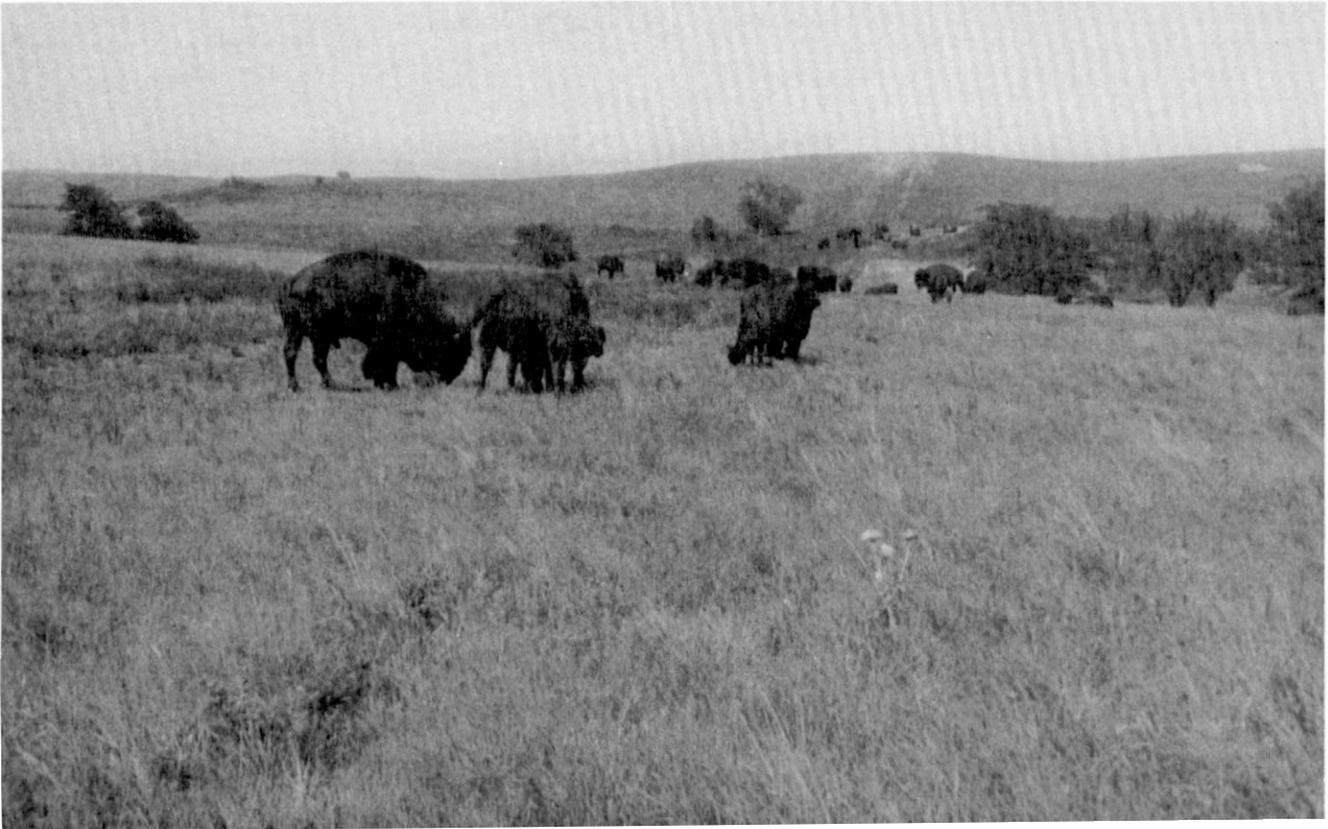


Figure 15.—Buffalo on well managed native range at the Maxwell Game Refuge. The soils are Lancaster-Hedville loams, 6 to 12 percent slopes.

The primary game species in McPherson County are the ringneck pheasant, bobwhite quail, cottontail rabbit, white-tailed deer, and several species of waterfowl. Nongame species are numerous because the habitat types are diverse. Cropland, woodland, and grassland are interspersed throughout the county. Each of these kinds of land provides habitat for a particular group of species.

Furbearers are sparse to common along the Smoky Hill and Little Arkansas Rivers and their tributaries. They are trapped on a limited basis.

McPherson State Fishing Lake, Lake Inman, and the many stock water ponds and streams provide good to excellent fishing. The species commonly caught are largemouth bass, bluegill, carp, channel catfish, bullhead, and flathead catfish.

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, grain sorghum, oats, 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, brome grass, clover, 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, switchgrass, indiangrass, grama, goldenrod, wheatgrass, ragweed, sunflowers, and native legumes.

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 native shrubs are plum, currant, dogwood, buckbrush, prairie rose, and sumac.

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, cattail, indigobush, saltgrass, prairie cordgrass, 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, mourning dove, pheasant, meadowlark, field sparrow, and cottontail rabbit.

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, redwing blackbirds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include jackrabbits, badgers, killdeer, and meadowlark.

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

engineering

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 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, large stones, 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, 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, and flooding affect absorption of the effluent. Large stones and bedrock 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, 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 and bedrock 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, 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 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 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, 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. 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 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 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.

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. "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 15 or 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

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, SP-SM.

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 oven-dry 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.

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 (oven-dry) 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 and the amount of soil lost. 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 18 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 18 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 and water in swamps and marshes are not considered flooding.

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, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of 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—that is, perched or apparent; 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.

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. A *perched water table* is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

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 specified as either soft or hard. If the rock is soft or fractured, excavations generally 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 excavations.

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 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.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (5). 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. In table 17, the soils of the survey area are classified according to the system. 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 Ustolls (*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 *ustolls*, the suborder of the Mollisols that have 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 *Pachic* identifies the subgroup that has a thicker surface layer than is typical for the great group. An example is Pachic 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, montmorillonitic, mesic Pachic 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* (4). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (5). 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."

Attica series

The Attica series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy and sandy eolian sediments. Slope ranges from 1 to 4 percent.

Attica soils are similar to Pratt soils and commonly are adjacent to Carwile, Plevna, and Pratt soils. Pratt soils are more sandy than the Attica soils. They are on the higher ridges. The nearly level, somewhat poorly drained Carwile soils are on the lower parts of the landscape.

They have a clayey subsoil. The poorly drained Plevna soils are in depressions.

Typical pedon of Attica loamy fine sand, 1 to 4 percent slopes (fig. 16), 200 feet south and 40 feet east of the northwest corner of sec. 6, T. 21 S., R. 5 W.

- Ap—0 to 10 inches; brown (10YR 5/3) loamy fine sand dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; few fine roots; medium acid; abrupt smooth boundary.
- Bt—10 to 25 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable; few fine roots; slightly acid; gradual smooth boundary.
- BC—25 to 45 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; soft, very friable; neutral; gradual smooth boundary.



Figure 16.—Typical profile of Attica loamy fine sand. The structure in the subsoil is weak. Depth is marked in feet.

- C—45 to 60 inches; light yellowish brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; massive; soft, very friable; neutral.

The thickness of the solum ranges from about 28 to 50 inches. The depth to carbonates is more than 30 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is dominantly loamy fine sand but in some pedons is fine sandy loam. It ranges from medium acid to neutral. The Bt horizon has hue of 7.5YR or 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is fine sandy loam or sandy loam. It is medium acid or slightly acid. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4. It is dominantly fine sandy loam or loamy fine sand, but in a few pedons it is sand or gravelly sand below a depth of 40 inches. It ranges from slightly acid to mildly alkaline.

Bridgeport series

The Bridgeport series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in calcareous alluvium. Slope is 0 to 1 percent.

Bridgeport soils are similar to McCook, Roxbury, and Tobin soils and commonly are adjacent to those soils. McCook soils are slightly higher on the landscape than the Bridgeport soils. Also, their subsoil contains less clay. Roxbury soils have a mollic epipedon that is more than 20 inches thick. They are farther from stream channels than the Bridgeport soils. Tobin soils do not have lime within a depth of 15 inches. They are on narrow flood plains.

Typical pedon of Bridgeport silt loam, 720 feet north and 2,600 feet east of the southwest corner of sec. 6, T. 17 S., R. 5 W.

- Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.
- A—7 to 14 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; strong effervescence; moderately alkaline; gradual smooth boundary.
- Bw—14 to 26 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—26 to 46 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; hard, friable; thin strata of sandy loam and darker colored sediments; few films of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—46 to 60 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive; soft, friable; strong effervescence; moderately alkaline.

The mollic epipedon is 10 to 20 inches thick. The depth to lime ranges from 0 to 15 inches. Reaction ranges from neutral to moderately alkaline in the A horizon and is mildly alkaline or moderately alkaline in the Bw and C horizons.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly silt loam, but the range includes loam and fine sandy loam. The Bw horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is loam, silt loam, or silty clay loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. In a few pedons it has faint mottles below a depth of 40 inches.

Carwile series

The Carwile series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in alluvium or eolian sediments. Slope is 0 to 1 percent.

Carwile soils commonly are adjacent to Attica, Drummond, Plevna, and Pratt soils. Attica, Drummond, and Pratt soils do not have a mollic epipedon. Attica and Pratt soils are slightly higher on the landscape than the Carwile soils. Also, their subsoil contains less clay. Drummond soils have a natric horizon. They are slightly lower on the landscape than the Carwile soils. Plevna soils are in depressions. Their subsoil contains less clay than that of the Carwile soils.

Typical pedon of Carwile fine sandy loam, 2,620 feet north and 300 feet east of the southwest corner of sec. 31, T. 21 S., R. 5 W.

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

A—5 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; few fine roots; slightly acid; gradual smooth boundary.

AB—16 to 21 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; hard, friable; few fine roots; slightly acid; gradual smooth boundary.

Bt1—21 to 37 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; many fine distinct yellowish brown (10YR 5/6) mottles; moderate medium blocky structure; very hard, very firm; few fine roots; common clay films; neutral; gradual smooth boundary.

Bt2—37 to 45 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium blocky structure; very hard, very firm; neutral; gradual smooth boundary.

C—45 to 60 inches; light gray (2.5Y 7/2) clay loam, light brownish gray (2.5Y 6/2) moist; common medium distinct yellowish brown (10YR 5/6) mottles; massive; hard, friable; few small black concretions; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes loamy fine sand, loam, and clay loam. The Bt horizon has hue of 10YR, 7.5YR, or 2.5Y, value of 3 to 6 (2 to 4 moist), and chroma of 1 or 2. It is clay loam, sandy clay, or clay. It ranges from slightly acid to mildly alkaline. The C horizon has hue of 5YR to 5Y, value of 4 to 7 (3 to 6 moist), and chroma of 1 to 6. It is fine sandy loam, sandy clay loam, clay loam, or clay.

Cass series

The Cass series consists of deep, well drained, moderately rapidly permeable soils on terraces. These soils formed in mixed loamy and sandy alluvium. Slope ranges from 0 to 2 percent.

Cass soils are similar to McCook soils and commonly are adjacent to Bridgeport and Tobin soils. McCook soils have lime within a depth of 10 inches. Bridgeport soils are in positions on the landscape similar to those of the Cass soils. Their subsoil contains less sand than that of the Cass soils. The occasionally flooded Tobin soils are on narrow flood plains along upland drainageways. They are less sandy than the Cass soils.

Typical pedon of Cass fine sandy loam, 2,600 feet north and 40 feet west of the southeast corner of sec. 20, T. 17 S., R. 1 W.

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

- A—7 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, friable; few fine roots; slightly acid; gradual smooth boundary.
- AC—16 to 25 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to fine and medium subangular blocky; soft, friable; few fine roots; slightly acid; gradual smooth boundary.
- C1—25 to 51 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, friable; faintly stratified with thin layers of more sandy and more silty material; neutral; diffuse smooth boundary.
- C2—51 to 60 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; massive; soft, friable; neutral.

The thickness of the mollic epipedon ranges from 10 to 20 inches. Typically, the depth to lime is more than 60 inches, but a few pedons have strata of lime at a depth of 25 to 60 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly fine sandy loam but in some pedons is loam or very fine sandy loam. It ranges from medium acid to neutral. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is dominantly fine sandy loam, sandy loam, or loamy fine sand, but in many pedons it has strata that are more sandy, more silty, or more loamy. It ranges from slightly acid to mildly alkaline.

Clime series

The Clime series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in residuum of calcareous, clayey shale. Slope ranges from 1 to 6 percent.

Clime soils commonly are adjacent to Edalgo and Irwin soils. The adjacent soils have an argillic horizon and do not have lime in the upper part of the solum. They are slightly higher on ridgetops and side slopes than the Clime soils.

Typical pedon of Clime silty clay, 3 to 6 percent slopes, 2,062 feet east and 110 feet south of the northwest corner of sec. 15, T. 18 S., R. 2 W.

- A—0 to 9 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, firm; common fine roots; slight effervescence; moderately alkaline; clear smooth boundary.
- Bw—9 to 15 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; few fine faint yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very hard, very firm; few fine roots; slight effervescence; moderately alkaline; gradual smooth boundary.

- C—15 to 27 inches; light gray (2.5Y 7/2) silty clay, grayish brown (2.5Y 5/2) moist; few fine faint brown (10YR 5/3) mottles; massive; very hard, firm; few fine roots; about 10 percent shale fragments less than one-half inch in diameter; slight effervescence; moderately alkaline; diffuse smooth boundary.
- Cr—27 inches; light gray (10YR 7/2), calcareous, clayey shale and some thin strata of olive gray (5Y 5/2) and brownish yellow (10YR 6/6) shale.

The thickness of the solum ranges from 12 to 30 inches. The depth to shale ranges from 20 to 40 inches. Lime generally is disseminated throughout the soil mass. In some pedons, however, the upper 10 inches contains no lime. The mollic epipedon ranges from 7 to 20 inches in thickness. Flaggy limestone fragments cover 0 to 15 percent of the surface.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silty clay, but the range includes silty clay loam. The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 to 3. It is clay, silty clay, or silty clay loam. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silty clay or clay.

Crete series

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

Crete soils are similar to Detroit, Irwin, Ladysmith, and Smolan soils and commonly are adjacent to Ladysmith, Longford, and Smolan soils. Detroit soils are on terraces. Their subsoil contains less clay than that of the Crete soils. Irwin soils are more clayey in the upper 15 inches than the Crete soils. The nearly level, somewhat poorly drained Ladysmith soils are on terraces and uplands. They are clayey in the upper part of the subsoil. Longford and Smolan soils are on side slopes. Their subsoil is redder than that of the Crete soils.

Typical pedon of Crete silt loam, 0 to 1 percent slopes, 950 feet south and 40 feet west of the northeast corner of sec. 25, T. 19 S., R. 5 W.

- Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak very fine granular structure; hard, friable; few fine roots; medium acid; abrupt smooth boundary.
- A—6 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, friable; few fine roots; medium acid; clear smooth boundary.

- BA—10 to 13 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; medium acid; gradual smooth boundary.
- Bt1—13 to 19 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium blocky structure; very hard, very firm; few fine roots; few dark coatings on faces of peds; slightly acid; clear smooth boundary.
- Bt2—19 to 25 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate fine and medium blocky; very hard, very firm; few fine roots; few dark coatings on faces of peds; neutral; clear smooth boundary.
- Bt3—25 to 32 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium blocky structure; very hard, very firm; neutral; gradual smooth boundary.
- BC—32 to 43 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium blocky structure; very hard, very firm; few fine lime concretions; slight effervescence; mildly alkaline; gradual smooth boundary.
- C—43 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; few fine and medium faint yellowish brown (10YR 5/6) mottles; massive; hard, friable; few fine lime accumulations; mildly alkaline.

The thickness of the mollic epipedon ranges from 20 to 36 inches. The depth to lime ranges from 25 to 42 inches. The lime generally occurs as soft accumulations or as concretions.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is silt loam or silty clay loam. It is medium acid or slightly acid. The upper part of the B horizon has hue of 10YR, value of 4 or 5 (3 moist), and chroma of 2 or 3. It is silty clay in which the content of clay ranges from 42 to 52 percent. The lower part of this horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is silty clay or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silty clay loam or silt loam.

Crete silty clay loam, 1 to 3 percent slopes, eroded, is a taxadjunct to the Crete series because the mollic epipedon typically is less than 20 inches thick. This difference, however, does not significantly affect the use or behavior of the soil.

Detroit series

The Detroit series consists of deep, moderately well drained, slowly permeable soils on terraces. These soils

formed in calcareous, silty alluvium. Slope is 0 to 1 percent.

Detroit soils are similar to Crete, New Cambria, and Smolan soils and commonly are adjacent to Hord, Roxbury, and Tobin soils. Crete soils are on uplands. Their subsoil contains more clay than that of the Detroit soils. New Cambria soils have lime within a depth of 15 inches. They are in slightly concave areas. Smolan soils are on uplands. Their subsoil is redder than that of the Detroit soils. Hord, Roxbury, and Tobin soils contain less clay in the subsoil than the Detroit soils. Hord and Roxbury soils are on terraces, and Tobin soils are on narrow flood plains.

Typical pedon of Detroit silty clay loam, 1,500 feet east and 100 feet north of the southwest corner of sec. 10, T. 21 S., R. 3 W.

- A—0 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable; common fine roots; slightly acid; gradual smooth boundary.
- Bt1—13 to 23 inches; dark grayish brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots; thin clay films on faces of some peds; neutral; gradual smooth boundary.
- Bt2—23 to 40 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak fine blocky structure; very hard, very firm; few fine threads of lime; neutral; gradual smooth boundary.
- C—40 to 60 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; few fine faint dark yellowish brown (10YR 5/6) mottles; massive; very hard, firm; few small lime concretions; slight effervescence; mildly alkaline.

The thickness of the solum ranges from about 24 to 48 inches. The depth to lime ranges from 22 to 50 inches. The thickness of the mollic epipedon ranges from 20 to 45 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is silty clay loam or silt loam. The Bt horizon has hue of 10YR, value of 3 to 5 (2 to 4 moist), and chroma of 2 or 3. It is silty clay loam or silty clay in which the content of clay ranges from 35 to 45 percent. It is neutral or mildly alkaline. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. Faint brownish mottles are below a depth of 40 inches in most pedons.

Drummond series

The Drummond series consists of deep, somewhat poorly drained, very slowly permeable, sodic soils on terraces. These soils formed in calcareous alluvium. Slope ranges from 0 to 3 percent.

The Drummond soils in McPherson County are taxadjuncts to the series because they typically have a mollic epipedon. This difference, however, does not significantly affect the use or behavior of the soils.

Drummond soils commonly are adjacent to Carwile and Ladysmith soils. The adjacent soils do not have a natric horizon. They are slightly higher on the landscape than the Drummond soils or are in similar positions.

Typical pedon of Drummond loam, 480 feet west and 120 feet south of the northeast corner of sec. 33, T. 21 S., R. 5 W.

A—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; hard, friable; many fine roots; the upper one-quarter inch is vesicular and crusted; slightly acid; clear smooth boundary.

Btn—7 to 19 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak medium columnar structure; very hard, very firm; many fine roots between peds; common pockets or seams of white crystals below 12 inches; clay films on faces of many peds; moderately alkaline; clear smooth boundary.

BCn—19 to 30 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; many coarse dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure; very hard, very firm; few fine roots; moderately alkaline; gradual smooth boundary.

C—30 to 60 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; common coarse dark yellowish brown (10YR 4/4) mottles; massive; hard, firm; few very dark brown concretions; moderately alkaline.

The thickness of the solum ranges from 20 to 50 inches. The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly loam but in some pedons is silt loam or fine sandy loam. It ranges from slightly acid to mildly alkaline. The Bt horizon has hue of 7.5YR, 10YR, 5Y, or 2.5Y, value of 4 to 7 (3 to 6 moist), and chroma of 1 to 4. It ranges from neutral to moderately alkaline. It is clay loam or clay in which the content of clay ranges from 35 to 60 percent. The content of exchangeable sodium ranges from 15 to 25 percent.

The C horizon has hue of 7.5YR to 2.5Y, value 5 to 7 (4 to 6 moist), and chroma of 1 to 4. It is dominantly clay loam, silty clay loam, or clay. In some pedons, however, it has thin strata that are more sandy or more clayey. It ranges from mildly alkaline to strongly alkaline.

Edalgo series

The Edalgo series consists of moderately deep, well drained, very slowly permeable soils on uplands. These

soils formed in residuum of clayey shale. Slope ranges from 3 to 12 percent.

Edalgo soils are similar to Irwin soils and commonly are adjacent to Clime, Hedville, Irwin, and Lancaster soils. Irwin soils are more than 40 inches deep over bedrock. They are on ridgetops and the upper side slopes. The calcareous Clime soils do not have an argillic horizon. They are on the lower side slopes. Hedville soils are 4 to 20 inches deep over sandstone bedrock. They are on the steeper upper side slopes and on narrow ridgetops. Lancaster soils contain less clay in the subsoil than the Edalgo soils. Their positions on the landscape are similar to those of the Edalgo soils.

Typical pedon of Edalgo silt loam, 5 to 12 percent slopes, 1,650 feet south and 960 feet west of the northeast corner of sec. 2, T. 18 S., R. 1 W.

A—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; medium acid; clear smooth boundary.

BA—6 to 15 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; few fine faint yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; hard, friable; common fine roots; medium acid; gradual smooth boundary.

Bt—15 to 30 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; common coarse yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very hard, firm; few fine roots; medium acid; gradual smooth boundary.

Cr—30 inches; light brownish gray (10YR 6/2) and brownish yellow (10YR 6/6) clayey shale.

The solum ranges from 20 to 36 inches in thickness. It is medium acid to neutral. The depth to shale ranges from 20 to 40 inches. The mollic epipedon ranges from 8 to 18 inches in thickness. Sandstone fragments 1 to 10 inches in diameter cover 0 to 10 percent of the surface.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam or silty clay loam, but the range includes loam and clay loam. The Bt horizon has hue of 10YR to 2.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 6. It is silty clay or silty clay loam.

Edalgo silty clay loam, 3 to 9 percent slopes, eroded, is a taxadjunct to the Edalgo series because it lacks a mollic epipedon. This difference, however, does not significantly affect the use or behavior of the soil.

Farnum series

The Farnum series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy old alluvium. Slope ranges from 1 to 3 percent.

Farnum soils are similar to Geary and Wells soils and commonly are adjacent to Crete and Goessel soils. The subsoil of Geary soils is more silty than that of the Farnum soils. Wells soils have a mollic epipedon that is less than 20 inches thick. The nearly level Crete and Goessel soils are on uplands. They have a clayey subsoil.

Typical pedon of Farnum loam, 1 to 3 percent slopes, about 1,360 feet north and 50 feet west of the southeast corner of sec. 4, T. 21 S., R. 1 W.

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

AB—6 to 12 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; slightly hard, friable; few fine roots; slightly acid; gradual smooth boundary.

Bt1—12 to 30 inches; brown (7.5YR 4/2) sandy clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm; few fine roots; clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—30 to 40 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; few medium faint strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; hard, firm; clay films on faces of peds; neutral; gradual smooth boundary.

Bt3—40 to 49 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; hard, firm; clay films on faces of peds; neutral; gradual smooth boundary.

C—49 to 60 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; common fine faint strong brown (7.5YR 5/6) mottles; hard, firm; neutral.

The mollic epipedon ranges from 20 to 40 inches in thickness. In some pedons lime is below a depth of 36 inches. Reaction ranges from medium acid to neutral in the A horizon and from neutral to moderately alkaline in the Bt and C horizons.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is loam, fine sandy loam, or sandy loam. The Bt horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is sandy clay loam or clay loam. The C horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4. It is loam, clay loam, sandy clay loam, sandy loam, or fine sandy loam.

Geary series

The Geary series consists of deep, well drained, moderately permeable soils on uplands. These soils

formed in reddish loess. Slope ranges from 1 to 3 percent.

Geary soils are similar to Farnum, Longford, and Wells soils and commonly are adjacent to Edalgo, Hord, and Lancaster soils. Their subsoil contains less sand than that of Farnum and Wells soils and less clay than that of Longford soils. Edalgo and Lancaster soils are 20 to 40 inches deep over bedrock. Edalgo soils are on the steeper side slopes, and Lancaster soils are on the upper side slopes. Hord soils do not have an argillic horizon. They are on stream terraces.

Typical pedon of Geary silt loam, 1 to 3 percent slopes, 2,570 feet west and 120 feet north of the southeast corner of sec. 21, T. 17 S., R. 5 W.

A—0 to 10 inches; brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; hard, friable; few fine roots; medium acid; gradual smooth boundary.

BA—10 to 16 inches; brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine roots; slightly acid; gradual smooth boundary.

Bt1—16 to 22 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; very hard, firm; slightly acid; gradual smooth boundary.

Bt2—22 to 32 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm; slightly acid; gradual smooth boundary.

BC—32 to 39 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak medium and coarse subangular blocky structure; very hard, firm; slightly acid; gradual smooth boundary.

C—39 to 60 inches; reddish yellow (7.5YR 6/6) silty clay loam, strong brown (7.5YR 5/6) moist; massive; hard, friable; neutral.

The thickness of the solum ranges from 30 to 60 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to lime ranges from 40 to more than 60 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is silt loam or silty clay loam. It is medium acid or slightly acid. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It ranges from medium acid to mildly alkaline. The C horizon has hue of 10YR, 7.5YR, or 5YR, value of 5 to 7 (4 or 5 moist), and chroma of 3 to 6. It is loam, silt loam, silty clay loam, or clay loam. It ranges from neutral to moderately alkaline.

Goessel series

The Goessel series consists of deep, moderately well drained, very slowly permeable soils on uplands. These

soils formed in clayey old alluvium. Slope ranges from 0 to 2 percent.

Goessel soils are similar to Ladysmith and Ness soils and commonly are adjacent to Farnum, Irwin, and Ladysmith soils. Ladysmith, Farnum, and Irwin soils have an argillic horizon. The surface layer of Ladysmith soils is less clayey than that of the Goessel soils, and that of Farnum and Irwin soils is less clayey and browner. Farnum and Irwin soils are in the more sloping areas. The poorly drained Ness soils are in depressions.

Typical pedon of Goessel silty clay, about 2,640 feet south and 150 feet east of the northwest corner of sec. 11, T. 21 S., R. 1 W.

- Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; moderate fine granular structure; very hard, very firm; few sand grains; slightly acid; clear smooth boundary.
- A—7 to 14 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; moderate fine and very fine blocky structure; very hard, very firm; few pores; few sand grains; neutral; gradual smooth boundary.
- AC1—14 to 25 inches; dark gray (10YR 4/1) and grayish brown (2.5Y 5/2) silty clay, very dark gray (10YR 3/1) and dark grayish brown (2.5Y 4/2) moist; moderate fine blocky structure; extremely hard, very firm; few pores; common slickensides inclined at a 45-degree angle from the horizontal; few sand grains; moderately alkaline; gradual smooth boundary.
- AC2—25 to 35 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; many fine distinct light brownish gray (2.5Y 6/2) and few fine distinct brown (7.5YR 4/4) mottles; moderate fine blocky structure; extremely hard, very firm; few pores; few fine lime concretions; few sand grains; moderately alkaline; gradual smooth boundary.
- AC3—35 to 50 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; few fine distinct light brownish gray (2.5Y 6/2) and brown (7.5YR 4/4) mottles; weak fine blocky structure; extremely hard, very firm; very few pores; few small lime concretions; few sand grains; moderately alkaline; gradual smooth boundary.
- C—50 to 60 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; common medium distinct brown (7.5YR 4/4) and few fine distinct light yellowish brown (2.5Y 6/4) mottles; massive; extremely hard, very firm; very few pores; few very fine lime concretions; very few fine black concretions; a noticeable increase in sand content from the content in the AC3 horizon; moderately alkaline.

The thickness of the solum ranges from 40 to 55 inches. Films, threads, or soft accumulations of lime commonly are at a depth of more than 30 inches.

The A horizon has hue of 10YR, value of 3 or 4 (2 or 3 moist), and chroma of 1. It is slightly acid or neutral. It is dominantly silty clay, but the range includes silty clay loam and clay. The AC horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5 (2 to 4 moist), and chroma of 1 or 2. It is silty clay or clay. It is mildly alkaline or moderately alkaline. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6 (2 to 5 moist), and chroma of 1 to 4. It is silty clay, clay, clay loam, or silty clay loam.

Hedville series

The Hedville series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in residuum of noncalcareous sandstone. Slope ranges from 6 to 12 percent.

Hedville soils are similar to Lancaster soils and commonly are adjacent to Edalgo, Geary, and Lancaster soils. Edalgo and Lancaster soils are 20 to 40 inches deep over bedrock. They are on the less sloping ridgetops and side slopes. Geary soils are more than 40 inches deep over bedrock. They are on the lower side slopes.

Typical pedon of Hedville loam, in an area of Lancaster-Hedville loams, 6 to 12 percent slopes, about 300 feet north and 30 feet east of the southwest corner of sec. 32, T. 19 S., R. 5 W.

- A1—0 to 11 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable; many fine roots; slightly acid; gradual smooth boundary.
- A2—11 to 15 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; common fine roots; few small sandstone fragments; slightly acid; clear irregular boundary extending into cracks and pockets of the underlying sandstone bedrock.
- R—15 inches; brown (10YR 5/3) sandstone.

The thickness of the solum, the thickness of the mollic epipedon, and the depth to sandstone bedrock range from 4 to 20 inches. The soils contain no lime. In some pedons they are stony, but the content of coarse fragments does not exceed 35 percent in any horizon.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly loam, but the range includes stony loam and sandy loam. In a few pedons a thin B or C horizon is between the mollic epipedon and the bedrock.

Hord series

The Hord series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in silty alluvium. Slope is 0 to 1 percent.

Hord soils are similar to Roxbury and Tobin soils and commonly are adjacent to Crete, Geary, and Roxbury soils. Roxbury soils have lime within a depth of 15 inches. The occasionally flooded Tobin soils are on narrow flood plains along drainageways. Crete and Geary soils are on uplands. Crete soils have a subsoil that is more clayey than that of the Hord soils, and Geary soils have one that is redder.

Typical pedon of Hord silt loam, about 1,940 feet south and 60 feet east of the northwest corner of sec. 5, T. 17 S., R. 3 W.

- Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable; few fine roots; slightly acid; abrupt smooth boundary.
- A—6 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable; few fine roots; slightly acid; gradual smooth boundary.
- Bw—13 to 27 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; hard, friable; few fine roots; neutral; gradual smooth boundary.
- BC—27 to 43 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak medium and coarse subangular blocky structure; hard, friable; few fine roots; neutral; gradual smooth boundary.
- C—43 to 60 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; massive; hard, friable; faintly stratified with thin bands of lighter or darker material; few small lime concretions; mildly alkaline.

The mollic epipedon ranges from 20 to 40 inches in thickness and extends into the B horizon. The depth to lime ranges from about 20 to 48 inches. Reaction is slightly acid or neutral in the A and Bw horizons and mildly alkaline or moderately alkaline in the C horizon.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam and silty clay loam, but the range includes loam. 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. The C 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, silt loam, or loam.

Irwin series

The Irwin series consists of deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in clayey sediments and in residuum of shale. Slope ranges from 1 to 3 percent.

Irwin soils are similar to Crete, Edalgo, Ladysmith, and Smolan soils and commonly are adjacent to Edalgo, Goessel, and Ladysmith soils. Crete soils are less clayey in the upper 15 inches than the Irwin soils. Edalgo soils

are 20 to 40 inches deep over bedrock. Ladysmith soils are grayer in the surface layer and the upper part of the subsoil than the Irwin soils. The subsoil of Smolan soils is redder than that of the Irwin soils. Goessel soils have a clayey surface layer. They are nearly level.

Typical pedon of Irwin silty clay loam, 1 to 3 percent slopes, 1,420 feet east and 330 feet south of the northwest corner of sec. 1, T. 18 S., R. 1 W.

- Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, friable; slightly acid; abrupt smooth boundary.
- AB—6 to 11 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, firm; medium acid; clear smooth boundary.
- Bt1—11 to 21 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, very firm; few clay films; slightly acid; gradual smooth boundary.
- Bt2—21 to 27 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium blocky structure; very hard, very firm; few clay films; slightly acid; gradual smooth boundary.
- BC—27 to 42 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; few fine faint yellowish brown (10YR 5/4) mottles; weak medium blocky structure; very hard, very firm; few clay films; few fine soft lime accumulations; mildly alkaline; gradual smooth boundary.
- Cr—42 inches; light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/4) shale.

The thickness of the solum ranges from 30 to 60 inches. The depth to shale ranges from 40 to more than 60 inches. A subhorizon in which the content of clay is more than 40 percent is within a depth of 14 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is silt loam, silty clay loam, or clay loam. It ranges from medium acid to neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is silty clay or clay. It ranges from slightly acid to mildly alkaline. Some pedons have a C horizon. This horizon has hue of 2.5Y to 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 5. It ranges from neutral to moderately alkaline.

Ladysmith series

The Ladysmith series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands and terraces. These soils formed in fine textured sediments. Slope is 0 to 1 percent.

Ladysmith soils are similar to Crete, Goessel, Irwin, and Smolan soils and commonly are adjacent to Crete, Drummond, Goessel, and Irwin soils. Crete and Irwin

soils are browner in the upper part of the subsoil than the Ladysmith soils. Goessel soils have a clayey surface layer. The subsoil of Smolan soils is redder than that of the Ladysmith soils. Drummond soils have a natric horizon. They are on terraces.

Typical pedon of Ladysmith silty clay loam, 0 to 1 percent slopes (fig. 17), 1,200 feet north and 100 feet east of the southwest corner of sec. 5, T. 21 S., R. 3 W.

A—0 to 8 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak fine and medium granular structure; hard, firm; few fine roots; medium acid; clear smooth boundary.

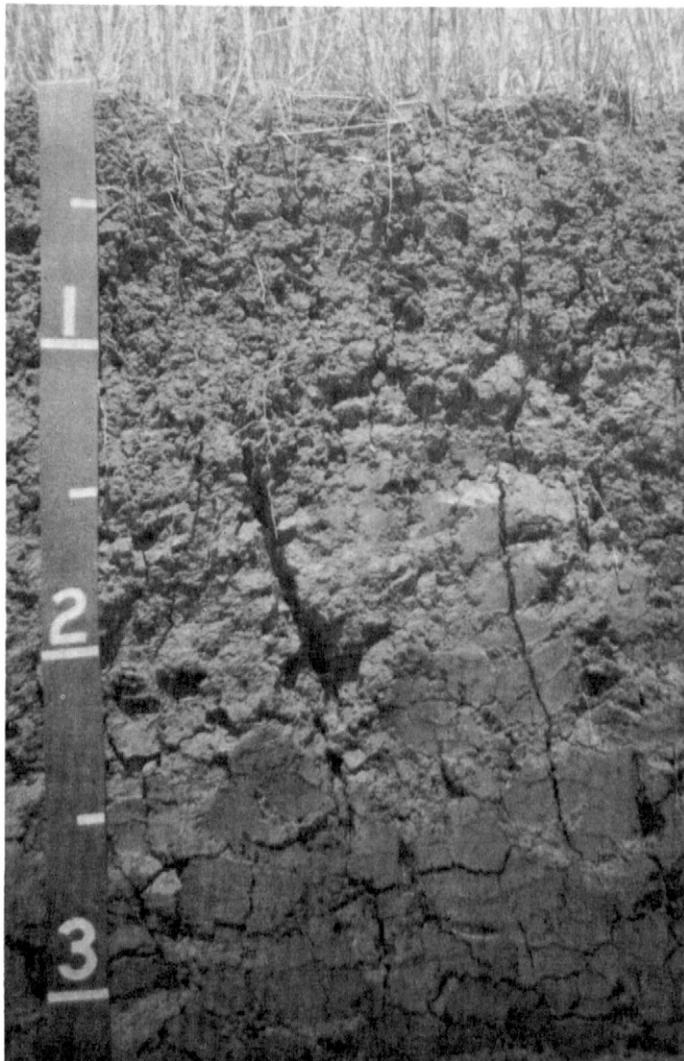


Figure 17.—Typical profile of Ladysmith silty clay loam. The cracks in the clay subsoil are the result of a high shrink-swell potential. Depth is marked in feet.

Bt1—8 to 20 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak fine and medium blocky structure; very hard, very firm; few fine roots; slightly acid; gradual smooth boundary.

Bt2—20 to 34 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; few fine faint brown (10YR 5/3) mottles below 30 inches; weak medium blocky structure; very hard, very firm; neutral; gradual smooth boundary.

BC—34 to 48 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; common fine faint brown (10YR 5/3) mottles; weak coarse blocky structure; very hard, very firm; few fine lime concretions; mildly alkaline; gradual smooth boundary.

C—48 to 60 inches; light gray (10YR 6/1) silty clay, gray (10YR 5/1) moist; common medium distinct strong brown (7.5YR 5/6) mottles; massive; very hard, very firm; few small black concretions; mildly alkaline.

The thickness of the solum ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 20 to 40 inches. The depth to lime ranges from 30 to 60 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or less. It is dominantly silty clay loam but in some pedons is silt loam. It ranges from medium acid to neutral. The Bt horizon is silty clay or clay. It is slightly acid or neutral. It has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 in the upper part and hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2 in the lower part. The C 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 silty clay loam, silty clay, or clay. It is mildly alkaline or moderately alkaline.

Lancaster series

The Lancaster series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in residuum of noncalcareous sandstone and sandy shale (fig. 18). Slope ranges from 2 to 12 percent.

Lancaster soils are similar to Geary, Hedville, and Wells soils and commonly are adjacent to those soils and to Edalgo soils. Geary and Wells soils are more than 40 inches deep over bedrock. They are on the tops and sides of the lower ridges. Hedville soils are 4 to 20 inches deep over bedrock. They are on narrow ridgetops and on the steeper upper side slopes. Edalgo soils are in positions on the landscape similar to those of the Lancaster soils. Their subsoil is more clayey than that of the Lancaster soils.

Typical pedon of Lancaster loam, 2 to 6 percent slopes, 660 feet west and 200 feet north of the southeast corner of sec. 31, T. 19 S., R. 5 W.

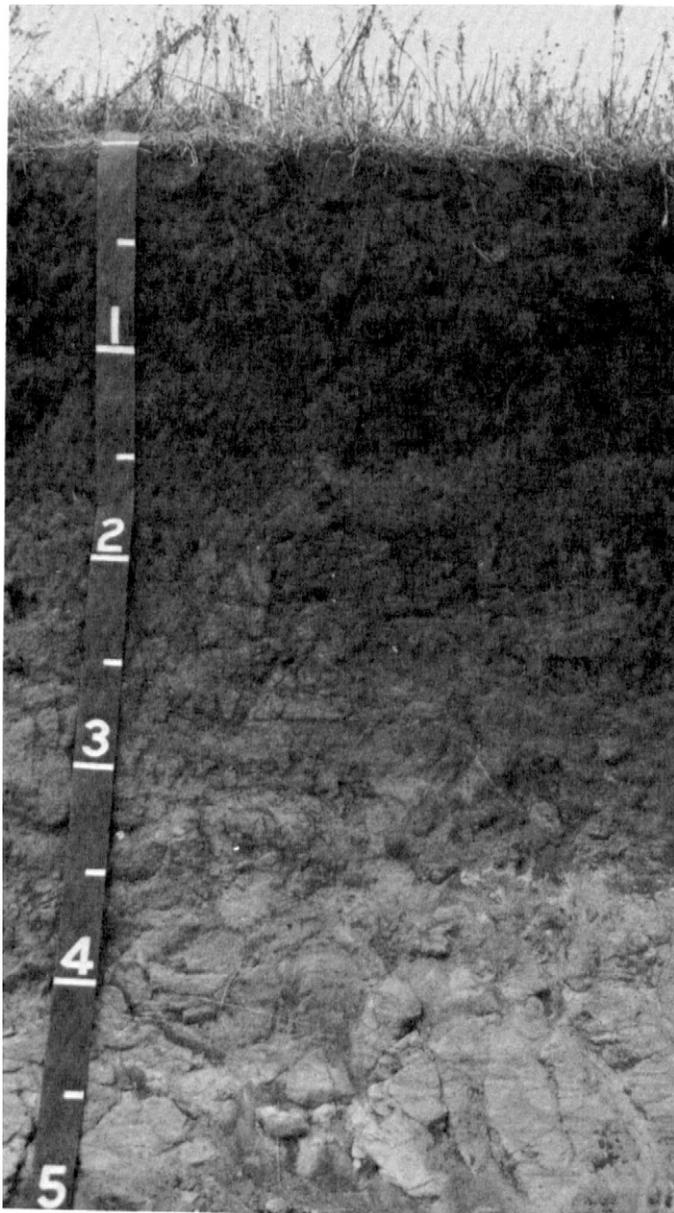


Figure 18.—Typical profile of Lancaster loam, which is underlain by sandstone and sandy shale. Depth is marked in feet.

- A—0 to 10 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak medium granular structure; hard, friable; many fine roots; medium acid; gradual smooth boundary.
- BA—10 to 14 inches; brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; hard, friable; common fine roots; few small sandstone fragments; medium acid; gradual smooth boundary.

- Bt—14 to 25 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots; few small sandstone fragments; slightly acid; gradual smooth boundary.
- BC—25 to 32 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; few medium and coarse faint reddish brown (5YR 5/4) mottles; weak medium blocky structure; very hard, firm; few small sandstone fragments; neutral; gradual smooth boundary.
- Cr—32 inches; sandy shale and sandstone.

The thickness of the solum ranges from 20 to 40 inches and is the same as the depth to sandy shale and weakly consolidated sandstone. The mollic epipedon is 8 to 10 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly loam but in some pedons is sandy loam or silt loam. It is medium acid or slightly acid. The Bt horizon has hue of 10YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is clay loam or sandy clay loam. It is slightly acid or neutral.

Longford series

The Longford series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in loess. Slope ranges from 2 to 6 percent.

Longford soils are similar to Geary and Smolan soils and commonly are adjacent to those soils and to Edalgo soils. The subsoil of Geary soils is less clayey than that of the Longford soils. Smolan soils have a mollic epipedon that is more than 20 inches thick. Edalgo soils are 20 to 40 inches deep over bedrock. They are on the steeper side slopes.

Typical pedon of Longford silty clay loam, 3 to 6 percent slopes, 1,150 feet east and 75 feet south of the northwest corner of sec. 22, T. 18 S., R. 5 W.

- A—0 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; medium acid; gradual smooth boundary.
- BA—10 to 15 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; hard, firm; common fine roots; slightly acid; gradual smooth boundary.
- Bt1—15 to 22 inches; reddish brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; very hard, very firm; few fine roots; slightly acid; gradual smooth boundary.

- Bt2—22 to 29 inches; reddish brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; moderate medium blocky structure; very hard, very firm; few fine roots; slightly acid; gradual smooth boundary.
- BC—29 to 47 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; very hard, very firm; few fine lime concretions; neutral; gradual smooth boundary.
- C—47 to 60 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; few fine and medium distinct dark grayish brown (10YR 4/2) mottles; massive; hard, firm; few fine lime concretions; neutral.

The solum ranges from 38 to 54 inches in thickness. The mollic epipedon is 10 to 20 inches thick. The depth to lime ranges from 36 to 60 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It is silty clay or silty clay loam. The C horizon has hue of 5YR, 7.5YR, or 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6. It is silty clay loam, clay loam, or silt loam.

McCook series

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

McCook soils are similar to Bridgeport, Cass, and Roxbury soils and commonly are adjacent to Bridgeport, Hord, and Roxbury soils. Their subsoil contains less clay than that of the Bridgeport soils and less sand than that of the Cass soils. Hord and Roxbury soils have a mollic epipedon that is 20 or more inches thick. Their positions on the landscape are similar to those of the McCook soils.

Typical pedon of McCook fine sandy loam, 880 feet north and 30 feet east of the southwest corner of sec. 8, T. 17 S., R. 5 W.

- Ap—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; few fine roots; slight effervescence; mildly alkaline; clear smooth boundary.
- A—6 to 14 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, very friable; few fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

- AC—14 to 28 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and medium granular structure; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.
- C—28 to 60 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 16 to 33 inches. The depth to lime is less than 10 inches, and most pedons are calcareous to the surface. The mollic epipedon is 10 to 20 inches thick. All horizons are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is very fine sandy loam, fine sandy loam, or loam. The AC and C horizons have hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. Some pedons have dark buried horizons or thin strata of loamy fine sand or silty clay loam below the AC horizon. A few have faint mottles below a depth of 30 inches.

Ness series

The Ness series consists of deep, poorly drained, very slowly permeable soils in depressions in the uplands. These soils formed in clayey alluvium and eolian sediments. Slope is 0 to 1 percent.

Ness soils are similar to Goessel soils and commonly are adjacent to Crete and Ladysmith soils. Goessel soils are moderately well drained. The moderately well drained Crete and somewhat poorly drained Ladysmith soils are on the slightly higher flats and side slopes. They have an argillic horizon.

Typical pedon of Ness silty clay, 1,980 feet south and 1,980 feet east of the northwest corner of sec. 21, T. 20 S., R. 4 W.

- A1—0 to 12 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; weak fine granular structure at the surface and weak fine and medium subangular blocky structure below; very hard, very firm; few fine roots; slightly acid; gradual wavy boundary.
- A2—12 to 24 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium blocky structure; very hard, very firm; few fine roots; few slickensides; slightly acid; gradual smooth boundary.
- C—24 to 60 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; few fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, firm; slightly acid.

The thickness of the solum ranges from 20 to 50 inches. All horizons are slightly acid or neutral.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1. It is clay or silty clay. Some pedons have an AC horizon. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 1 or 2.

New Cambria series

The New Cambria series consists of deep, moderately well drained, slowly permeable soils on terraces. These soils formed in calcareous, clayey alluvium. Slope is 0 to 1 percent.

New Cambria soils are similar to Detroit soils and commonly are adjacent to Detroit, Hord, and Roxbury soils. Detroit soils do not have lime within a depth of 15 inches. Hord and Roxbury soils are on the slightly higher terraces. Their subsoil is less clayey than that of the New Cambria soils.

Typical pedon of New Cambria silty clay, about 1,320 feet south and 1,320 feet east of the northwest corner of sec. 26, T. 17 S., R. 4 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; very hard, firm; mildly alkaline; abrupt smooth boundary.

A—6 to 12 inches; very dark grayish brown (10YR 3/2) silty clay, black (10YR 2/1) moist; moderate fine and medium granular structure; very hard, very firm; few fine roots; mildly alkaline; gradual smooth boundary.

Bw—12 to 25 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; extremely hard, very firm; few fine roots; few fine accumulations of lime; slight effervescence; moderately alkaline; diffuse smooth boundary.

Ab—25 to 32 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium subangular blocky structure; extremely hard, very firm; few fine accumulations of lime; slight effervescence; moderately alkaline; diffuse smooth boundary.

C—32 to 60 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; few fine faint dark yellowish brown (10YR 4/4) mottles below 40 inches; weak medium subangular blocky structure; very hard, very firm; few fine sand grains below 40 inches; few very fine accumulations of lime; slight effervescence; moderately alkaline.

The mollic epipedon ranges from 20 to 48 inches in thickness. The depth to lime ranges from 0 to 15 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is mildly alkaline or neutral. It is dominantly silty clay, but the range includes clay and silty clay loam. The Bw horizon

has colors like those of the A horizon. It is silty clay or clay.

Plevna series

The Plevna series consists of deep, poorly drained, moderately rapidly permeable soils in depressions in the sandhills. These soils formed in loamy alluvium. Slope is 0 to 1 percent.

Plevna soils commonly are adjacent to Attica, Carwile, and Pratt soils on the higher parts of the uplands. Attica soils lack a mollic epipedon. Carwile soils have an argillic horizon and a mottled subsoil. Pratt soils have a sandy subsoil.

Typical pedon of Plevna fine sandy loam, 835 feet west and 330 feet north of the center of sec. 32, T. 21 S., R. 5 W.

A1—0 to 9 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, friable; many fine roots; mildly alkaline; gradual smooth boundary.

A2—9 to 18 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable; many fine roots; mildly alkaline; gradual smooth boundary.

Bg—18 to 36 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; many fine faint dark gray (5Y 4/1) and few medium distinct yellowish brown (10YR 5/6) mottles; massive; hard, friable; common fine roots; strong effervescence below 22 inches; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; light yellowish brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; soft, friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from about 30 to 54 inches. The thickness of the mollic epipedon ranges from 10 to 24 inches. All horizons range from neutral to moderately alkaline.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes sandy loam and loamy fine sand. The Bg horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 or 2. It is fine sandy loam or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4. It is loamy fine sand, fine sand, or sand.

Pratt series

The Pratt series consists of deep, well drained, rapidly permeable soils on uplands. These soils formed in sandy eolian deposits. Slope ranges from about 6 to 12 percent.

Pratt soils are similar to Attica soils and commonly are adjacent to Attica, Carwile, and Plevna soils. Attica soils have a loamy subsoil. They are on the less sloping uplands. The nearly level, somewhat poorly drained Carwile soils are slightly lower on the landscape than the Pratt soils. Also, their subsoil is more clayey. The poorly drained Plevna soils are in depressions. They have a loamy subsoil.

Typical pedon of Pratt loamy fine sand, rolling, 1,360 feet south and 60 feet west of the northeast corner of sec. 32, T. 21 S., R. 5 W.

A—0 to 11 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, friable; slightly acid; gradual smooth boundary.

Bt—11 to 36 inches; brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; weak coarse prismatic structure; few darker shiny films on faces of some peds; soft, very friable; slightly acid; diffuse smooth boundary.

C—36 to 60 inches; brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; weak medium subangular blocky structure; loose; soft, friable; slightly acid.

The solum ranges from about 24 to 50 inches in thickness. It is medium acid to neutral. The upper 40 inches contains no lime.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 1 to 3. It is loamy fine sand or fine sand. The Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 6. It is loamy sand or loamy fine sand. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4. It is loamy fine sand or fine sand. It is slightly acid or neutral.

Roxbury series

The Roxbury series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in calcareous, loamy alluvium. Slope is 0 to 1 percent.

Roxbury soils are similar to Bridgeport, Hord, McCook, and Tobin soils and commonly are adjacent to Bridgeport, Detroit, and Hord soils. Bridgeport soils have a mollic epipedon that is 10 to 20 inches thick. Hord and Tobin soils do not have lime within a depth of 15 inches. McCook soils are less clayey than the Roxbury soils. Detroit soils are slightly higher on the terraces than the Roxbury soils. Also, they have a more clayey subsoil.

Typical pedon of Roxbury silty clay loam, 500 feet east and 75 feet north of the southwest corner of NW1/4 sec. 3, T. 17 S., R. 3 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; few fine roots; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—8 to 21 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; few fine roots; strong effervescence; mildly alkaline; gradual smooth boundary.

Bw—21 to 36 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable; few fine pores; strong effervescence; mildly alkaline; gradual smooth boundary.

C1—36 to 50 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; faintly stratified with thin layers of slightly darker material; massive; hard, friable; few fine pores; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—50 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; distinctly stratified with thin layers of darker and lighter material; massive; hard, friable; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 60 inches. The mollic epipedon is 20 inches or more thick. The depth to lime ranges from 0 to 15 inches. All horizons are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam and loam. The Bw horizon has hue of 10YR, value of 4 to 6 (3 or 4 moist), and chroma of 1 or 2. It is silt loam or silty clay loam. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is dominantly loam, silt loam, or silty clay loam. In some pedons, however, it has sandy or clayey strata below a depth of 40 inches.

Smolan series

The Smolan series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in reddish brown loess. Slope ranges from 1 to 3 percent.

Smolan soils are similar to Crete, Detroit, Ladysmith, and Longford soils and commonly are adjacent to Crete, Edalgo, and Wells soils. Crete, Detroit, and Ladysmith soils are less red in the subsoil than the Smolan soils. Longford soils have a mollic epipedon that is 10 to 20 inches thick. Edalgo soils are 20 to 40 inches deep over bedrock. They are on the steeper side slopes. Wells soils are on the lower side slopes. Their subsoil is less clayey than that of the Smolan soils.

Typical pedon of Smolan silty clay loam, 1 to 3 percent slopes, 1,420 feet west and 50 feet north of the southeast corner of sec. 9, T. 21 S., R. 4 W.

- Ap—0 to 6 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; common fine roots; medium acid; abrupt smooth boundary.
- A—6 to 11 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; common fine roots; medium acid; gradual smooth boundary.
- BA—11 to 16 inches; dark reddish gray (5YR 4/2) silty clay, dark reddish brown (5YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; slightly acid; gradual smooth boundary.
- Bt—16 to 32 inches; dark reddish gray (5YR 4/2) silty clay, dark reddish brown (5YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; slightly acid; gradual smooth boundary.
- BC—32 to 47 inches; reddish brown (5YR 5/3) silty clay, reddish brown (5YR 4/3) moist; weak medium and coarse subangular blocky structure; very hard, very firm; neutral; gradual smooth boundary.
- C—47 to 60 inches; reddish brown (5YR 5/4) silty clay, reddish brown (5YR 4/4) moist; massive; very hard, very firm; neutral.

The solum ranges from 38 to 60 inches in thickness. The mollic epipedon ranges from 20 to 40 inches in thickness. The depth to lime ranges from 30 to more than 60 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is silt loam or silty clay loam. It ranges from medium acid to neutral. The Bt horizon is silty clay or silty clay loam. It ranges from medium acid to mildly alkaline. It has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. The C horizon has hue of 7.5YR or 5YR, value of 5 or 6 (3 or 4 moist), and chroma of 3 to 6. It is neutral or mildly alkaline.

Tobin series

The Tobin series consists of deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slope is 0 to 1 percent.

Tobin soils are similar to Bridgeport, Hord, and Roxbury soils and commonly are adjacent to those soils. Bridgeport and Roxbury soils have lime within a depth of 15 inches. Also, Bridgeport soils have a mollic epipedon that is 10 to 20 inches thick. Hord soils are on rarely flooded terraces.

Typical pedon of Tobin silt loam, occasionally flooded, about 1,100 feet north and 100 feet east of the southwest corner of sec. 26, T. 21 S., R. 3 W.

- A—0 to 24 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable; many fine roots; slightly acid; gradual smooth boundary.
- C1—24 to 39 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; few fine roots; neutral; diffuse smooth boundary.
- C2—39 to 60 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; few fine faint brown (7.5YR 5/4) mottles; massive; slightly hard, friable; faintly stratified with thin layers of lighter or darker material; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 45 inches and is the same as the thickness of the A horizon. The depth to lime ranges from 15 to 40 inches.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam but in some pedons is silty clay loam. It ranges from slightly acid to mildly alkaline. The C horizon has hue of 10YR or 2.5Y, 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 more sandy or more clayey material.

Wells series

The Wells series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in old alluvium. Slope ranges from 1 to 6 percent.

Wells soils are similar to Farnum, Geary, and Lancaster soils and commonly are adjacent to Lancaster and Smolan soils. Farnum soils have a mollic epipedon that is more than 20 inches thick. The subsoil of Geary soils is more silty than that of the Wells soils. Lancaster soils are 20 to 40 inches deep over bedrock. Smolan soils are slightly higher on the landscape than the Wells soils. Also, their subsoil is more clayey.

Typical pedon of Wells loam, 3 to 6 percent slopes, 825 feet east and 100 feet north of the southwest corner of sec. 18, T. 17 S., R. 5 W.

- A—0 to 11 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; medium acid; gradual smooth boundary.
- BA—11 to 15 inches; reddish brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; hard, firm; common fine roots; slightly acid; gradual smooth boundary.

- Bt—15 to 37 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate medium blocky structure; hard, firm; few fine roots; slightly acid; gradual smooth boundary.
- BC—37 to 49 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium blocky structure; hard, firm; slightly acid; gradual smooth boundary.
- C—49 to 60 inches; reddish yellow (5YR 6/6) sandy loam, yellowish red (5YR 5/6) moist; massive; hard, friable; many pebbles and coarse sand grains; mildly alkaline.

The thickness of the solum ranges from 35 to 55 inches. The thickness of the mollic epipedon ranges from 12 to 20 inches. The upper 34 inches contains no lime.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly loam but in some pedons is fine sandy loam. It is medium acid or slightly acid. The Bt horizon has hue of 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is slightly acid or neutral. The C horizon has hue of 5YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 4 to 6. It ranges from slightly acid to mildly alkaline.

formation of the soils

The characteristics of a soil at any given place are determined by the interaction among five factors of soil formation—climate, plants and other living organisms, parent material, relief, and time. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The effects of the individual factors vary from place to place. The interaction among the factors is more complex for some soils than for others.

Climate and vegetation act on the parent material and gradually change it to a natural body of soil. Relief modifies the effects of climate and vegetation, mainly through its effect on runoff and temperature. The nature of the parent material helps to determine the kind of soil that forms. Time is needed for changing the parent material into a soil. Generally, a long period is needed for the formation of distinct horizons.

parent material

Parent material is the weathered rock or partly weathered material in which soils form. It affects texture, structure, color, natural fertility, and many other soil properties. The soils in McPherson County formed in alluvium, eolian sand, loess, and residuum of clayey shale, sandy shale, or sandstone.

Old and recent alluvium is sediment that has been transported by water. The old alluvial sediment is on high terraces and uplands. It is of the Quaternary period. Farnum and Goessel soils formed in this material. The recent alluvial sediment is on flood plains and low terraces. In the larger valleys, such as that of the Smoky Hill River, it generally has been transported long distances and ranges from clayey to loamy. Bridgeport, Hord, McCook, New Cambria, and Roxbury soils formed in this material. Tobin soils, which are in the smaller valleys, formed in generally silty alluvium of local origin.

Eolian sand is sandy material transported by wind. The source of the eolian material in McPherson County is the alluvial sediment in the valley of the Little Arkansas River. When the wind deposited and reworked the sediment, knolls and swells formed. Attica and Pratt soils formed in this sandy material.

Loess is silty wind-deposited material, some of which has been carried hundreds of miles from its source. Peoria Loess of the Wisconsin Glaciation covers many of the uplands in the county. It was deposited during the Pleistocene epoch. In most areas it is brown or light

gray, calcareous, and friable Crete soils formed in this material. Loveland Loess is light reddish brown material deposited during Illinoian time. Geary, Longford, and Smolan soils formed in this material.

The bedrock that crops out in McPherson County, mainly in the northern part, is dominantly shale and sandstone. The calcareous Clime soils formed in residuum of calcareous, clayey shale. Edalgo soils formed in residuum of noncalcareous, clayey shale. Hedville and Lancaster soils formed in material weathered from sandstone of the Lower Cretaceous System.

climate

Climate is an active factor of soil formation. It directly affects soil formation by weathering the parent material. It indirectly affects soil formation through its effect on plant and animal life.

The climate of McPherson County is 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. The accumulation of soft lime in the substratum of Crete soils is an indication of this excess moisture. As a result 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 generally affect the content of nutrients and of organic matter in the soil and the color of the surface layer. Bacteria and fungi help to decompose the plants, thus releasing more plant nutrients. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous.

The mid and tall prairie grasses have greatly affected soil formation in McPherson County. The decomposed remains of these grasses have accumulated over a long period. As a result, the upper part of a typical soil in the county is dark and has a high content of organic matter.

relief

Relief affects soil formation through its effect on drainage, runoff, plant cover, and soil temperature. The soil temperature is slightly lower, for example, on east- and north-facing slopes than on west- and south-facing slopes. Most important is the effect of relief on the movement of water on the surface and into the soil.

Runoff is more rapid on the more strongly sloping upland soils than on the less sloping soils. As a result, erosion is more extensive. Relief has retarded the formation of Hedville soils, which formed in old parent material. Runoff is rapid in the steeper areas of these soils. As a result, much of the soil material is removed as soon as the soil forms. In contrast, the nearly level and gently sloping soils generally have distinct horizons. An example is the nearly level Roxbury soils on stream

terraces. These soils formed in the younger parent material in the county. Most of the precipitation received by these soils penetrates the surface.

time

The length of time that the parent material has been in place commonly is reflected by the degree of profile development. Some soils form rapidly; others form slowly. The soils in McPherson County range from immature to mature. Roxbury and other soils on bottom land receive new sediment during periods of flooding. They have a thick, dark surface layer, but they are considered immature because the soil structure is weak. In Crete and other mature soils, the soil structure is stronger and the horizons are more distinct.

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glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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—

	<i>Inches</i>
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.

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.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water control measures on a complex slope is difficult.

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.

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.

Cover crop. A close growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

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.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to

wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by 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 does not provide 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, tillage, and other growth factors are favorable.

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.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

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, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon below an O or A horizon and above a B horizon. The E horizon is characterized by a loss of some combination of silicate clay, iron, and aluminum and by a remaining concentration of sand and silt particles of quartz or other resistant minerals.

B horizon.—The mineral horizon below an A, E, or O horizon. The B horizon is in part a layer of transition from the overlying A 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) prismatic or angular or subangular blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A, E, and B horizons are generally called the solum. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A, E, or B 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.

R layer.—Hard bedrock beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

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.

Increasesers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasesers commonly are the shorter plants and the less palatable to livestock.

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.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2.....	very low
0.2 to 0.4.....	low
0.4 to 0.75.....	moderately low
0.75 to 1.25.....	moderate
1.25 to 1.75.....	moderately high
1.75 to 2.5.....	high
More than 2.5.....	very high

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.

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.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

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.

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.

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 0.20 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.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

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—

	<i>pH</i>
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.

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.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

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.

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.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure 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 (7.5 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 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	<i>Millimeters</i>
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.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

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 profile 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 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. Includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series

recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior

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.

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.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION
 [Recorded in the period 1951-76 at McPherson, Kansas]

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have--		Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--		Less than--	More than--		
<u>of</u>	<u>of</u>	<u>of</u>	<u>of</u>	<u>of</u>	<u>In</u>	<u>In</u>	<u>In</u>		<u>In</u>	
January----	40.5	19.1	29.8	69	-8	0.52	0.08	0.97	2	3.8
February---	47.2	23.8	35.5	78	-3	.88	.15	1.65	2	5.1
March-----	55.7	30.7	43.2	85	4	1.90	.40	2.57	4	3.9
April-----	68.3	42.7	55.5	89	19	2.61	1.13	3.79	5	.8
May-----	77.6	52.9	65.3	95	31	4.38	2.00	6.34	6	.0
June-----	88.1	62.6	75.4	104	44	4.63	1.97	7.41	7	.0
July-----	93.6	67.8	80.7	106	50	3.41	1.07	5.48	5	.0
August-----	92.6	66.2	79.4	108	50	2.53	1.19	3.93	4	.0
September--	82.2	57.2	69.7	102	37	3.77	1.51	5.83	5	.0
October----	71.8	46.2	59.0	92	23	2.20	.66	3.74	4	.0
November---	55.1	32.4	43.8	76	5	1.22	.11	2.51	3	1.7
December---	44.0	23.0	33.5	69	-5	.88	.29	1.28	2	3.8
Year-----	68.1	43.7	55.9	108	-10	28.93	20.12	36.99	49	19.1

TABLE 2.--FREEZE DATES IN SPRING AND FALL
 [Recorded in the period 1931-60 at McPherson, Kansas]

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--	April 11	April 23	May 4
2 years in 10 later than--	April 6	April 18	April 29
5 years in 10 later than--	March 28	April 8	April 19
First freezing temperature in fall:			
1 year in 10 earlier than--	October 28	October 19	October 8
2 years in 10 earlier than--	November 1	October 24	October 12
5 years in 10 earlier than--	November 11	November 2	October 22

TABLE 3.--GROWING SEASON
 [Recorded in the period 1931-60 at McPherson, Kansas]

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	206	187	164
8 years in 10	213	194	171
5 years in 10	228	208	186
2 years in 10	242	222	200
1 year in 10	249	229	207

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
At	Attica loamy fine sand, 1 to 4 percent slopes-----	2,220	0.4
Br	Bridgeport silt loam-----	9,230	1.6
Ca	Carwile fine sandy loam-----	5,180	0.9
Cb	Cass fine sandy loam-----	3,460	0.6
Ce	Clime silty clay, 1 to 3 percent slopes-----	4,960	0.9
Cm	Clime silty clay, 3 to 6 percent slopes-----	7,840	1.4
Cr	Crete silt loam, 0 to 1 percent slopes-----	101,140	17.7
Cs	Crete silt loam, 1 to 3 percent slopes-----	92,100	16.1
Ct	Crete silty clay loam, 1 to 3 percent slopes, eroded-----	6,200	1.1
De	Detroit silty clay loam-----	5,100	0.9
Dr	Drummond loam-----	810	0.1
Ed	Edalgo silt loam, 5 to 12 percent slopes-----	11,760	2.1
Ee	Edalgo silty clay loam, 3 to 9 percent slopes, eroded-----	1,300	0.2
Fa	Farnum loam, 1 to 3 percent slopes-----	11,660	2.0
Ge	Geary silt loam, 1 to 3 percent slopes-----	2,050	0.4
Go	Goessel silty clay-----	18,800	3.3
Ho	Hord silt loam-----	14,560	2.5
Ir	Irwin silty clay loam, 1 to 3 percent slopes-----	17,830	3.1
La	Ladysmith silty clay loam, 0 to 1 percent slopes-----	78,480	13.7
Ld	Ladysmith-Drummond complex-----	772	0.1
Le	Lancaster loam, 2 to 6 percent slopes-----	10,300	1.8
Lh	Lancaster-Hedville loams, 6 to 12 percent slopes-----	62,700	10.9
Ln	Longford silty clay loam, 3 to 6 percent slopes-----	23,160	4.0
Lo	Longford silty clay loam, 2 to 6 percent slopes, eroded-----	5,960	1.0
Mc	McCook fine sandy loam-----	1,700	0.3
Ns	Ness silty clay-----	700	0.1
Nw	New Cambria silty clay-----	1,600	0.3
Pa	Plevna fine sandy loam-----	700	0.1
Pr	Pratt loamy fine sand, rolling-----	400	0.1
Ro	Roxbury silty clay loam-----	8,600	1.5
Sm	Smolan silty clay loam, 1 to 3 percent slopes-----	26,140	4.6
To	Tobin silt loam, occasionally flooded-----	24,140	4.2
Wb	Wells loam, 1 to 3 percent slopes-----	5,400	0.9
Wc	Wells loam, 3 to 6 percent slopes-----	6,360	1.1
	Water-----	128	*
	Total-----	573,440	100.0

* Less than 0.1 percent.

TABLE 5.--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. Only arable soils are listed. 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	Grain sorghum		Winter wheat		Alfalfa hay		Corn		Smooth brome grass	
	N Bu	I Bu	N Bu	I Bu	N Ton	I Ton	N Bu	I Bu	N AUM*	I AUM*
At----- Attica	52	100	32	42	3.0	6.0	---	120	5.0	10.0
Br----- Bridgeport	58	115	36	55	3.5	6.5	62	130	5.5	11.0
Ca----- Carwile	52	---	32	---	---	---	---	---	5.0	---
Cb----- Cass	56	105	32	42	3.0	6.0	60	125	5.5	11.0
Ce----- Clime	46	---	30	---	1.8	---	---	---	4.0	---
Cm----- Clime	42	---	27	---	1.6	---	---	---	4.0	---
Cr----- Crete	56	110	37	50	3.0	5.5	---	125	5.0	11.0
Cs----- Crete	52	105	35	50	3.0	5.5	---	120	4.5	10.0
Ct----- Crete	48	---	30	---	---	---	---	---	4.0	10.0
De----- Detroit	60	110	38	55	3.5	6.0	---	125	5.0	11.0
Ed----- Edalgo	42	---	28	---	---	---	---	---	4.5	---
Ee----- Edalgo	38	---	22	---	---	---	---	---	4.0	---
Fa----- Farnum	58	110	37	50	3.0	6.5	---	125	5.5	11.0
Ge----- Geary	58	115	36	55	3.5	6.5	---	125	5.5	11.0
Go----- Goessel	50	---	35	---	2.8	---	---	---	4.0	---
Ho----- Hord	62	120	40	55	3.5	6.5	65	135	5.5	11.0
Ir----- Irwin	50	---	34	---	3.0	---	---	---	5.0	10.0
La----- Ladysmith	54	---	36	---	3.0	---	---	---	5.0	---
Ld----- Ladysmith-Drummond	42	---	27	---	---	---	---	---	4.5	---
Le----- Lancaster	52	---	30	---	3.0	---	---	---	5.0	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Grain sorghum		Winter wheat		Alfalfa hay		Corn		Smooth bromegrass	
	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Ton	Ton	Bu	Bu	AUM*	AUM*
Ln----- Longford	46	---	31	---	2.5	---	---	---	5.0	---
Lo----- Longford	42	---	28	---	2.0	---	---	---	5.0	---
Mc----- McCook	60	110	39	50	3.0	6.2	55	125	5.5	11.0
Nw----- New Cambria	50	105	35	45	3.0	5.5	---	---	5.0	9.0
Pr----- Pratt	48	85	26	40	2.8	5.5	---	100	3.0	8.0
Ro----- Roxbury	60	115	40	55	3.5	6.5	62	130	5.5	11.0
Sm----- Smolan	52	105	35	50	3.0	5.5	---	120	4.5	10.0
To----- Tobin	56	115	35	50	3.5	6.0	60	125	5.5	11.0
Wb----- Wells	58	115	36	55	3.5	6.5	---	120	5.5	11.0
Wc----- Wells	54	---	33	---	3.0	---	---	---	5.5	---

* 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.

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 name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		
At----- Attica	Sandy-----	Favorable	4,500	Sand bluestem-----	20
		Normal	3,000	Little bluestem-----	20
		Unfavorable	2,000	Indiangrass-----	10
				Switchgrass-----	10
				Big bluestem-----	10
				Sand lovegrass-----	5
				Sand dropseed-----	5
Blue grama-----	5				
Br----- Bridgeport	Loamy Terrace-----	Favorable	5,500	Big bluestem-----	35
		Normal	4,500	Western wheatgrass-----	15
		Unfavorable	3,000	Switchgrass-----	10
				Little bluestem-----	10
				Sideoats grama-----	10
Indiangrass-----	5				
Ca----- Carwile	Sandy Lowland-----	Favorable	5,000	Switchgrass-----	25
		Normal	3,800	Little bluestem-----	15
		Unfavorable	3,000	Indiangrass-----	10
				Sand bluestem-----	5
				Scribner panicum-----	5
				Canada wildrye-----	5
Sideoats grama-----	5				
Cb----- Cass	Sandy Lowland-----	Favorable	5,500	Sand bluestem-----	30
		Normal	4,000	Little bluestem-----	15
		Unfavorable	3,000	Switchgrass-----	15
				Indiangrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	5
				Sedge-----	5
Ce, Cm----- Clime	Limy Upland-----	Favorable	4,500	Little bluestem-----	30
		Normal	3,500	Big bluestem-----	20
		Unfavorable	2,500	Sideoats grama-----	15
				Indiangrass-----	5
				Switchgrass-----	5
Blue grama-----	5				
Cr, Cs----- Crete	Clay Upland-----	Favorable	4,500	Big bluestem-----	25
		Normal	3,500	Little bluestem-----	15
		Unfavorable	2,000	Switchgrass-----	10
				Sideoats grama-----	10
				Indiangrass-----	5
				Western wheatgrass-----	5
				Tall dropseed-----	5
Ct----- Crete	Clay Upland-----	Favorable	4,500	Big bluestem-----	25
		Normal	3,500	Little bluestem-----	15
		Unfavorable	2,000	Switchgrass-----	10
				Sideoats grama-----	10
				Indiangrass-----	5
				Western wheatgrass-----	5
Tall dropseed-----	5				

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
De----- Detroit	Loamy Terrace-----	Favorable	5,500	Big bluestem-----	30
		Normal	4,500	Little bluestem-----	10
		Unfavorable	3,000	Switchgrass-----	10
				Western wheatgrass-----	10
				Sideoats grama-----	10
				Indiangrass-----	5
Dr----- Drummond	Saline Lowland-----	Favorable	7,000	Prairie cordgrass-----	30
		Normal	5,800	Switchgrass-----	10
		Unfavorable	5,000	Indiangrass-----	10
				Inland saltgrass-----	10
				Little bluestem-----	5
				Western wheatgrass-----	5
				Alkali sacaton-----	5
				Sunflower-----	5
				Sedge-----	5
Ed, Ee----- Edalgo	Clay Upland-----	Favorable	5,000	Big bluestem-----	30
		Normal	3,500	Little bluestem-----	15
		Unfavorable	2,000	Switchgrass-----	15
				Indiangrass-----	10
				Sideoats grama-----	5
Fa----- Farnum	Loamy Upland-----	Favorable	5,000	Little bluestem-----	25
		Normal	3,500	Big bluestem-----	20
		Unfavorable	2,500	Indiangrass-----	10
				Switchgrass-----	10
				Sand bluestem-----	10
Ge----- Geary	Loamy Upland-----	Favorable	6,000	Big bluestem-----	35
		Normal	4,000	Little bluestem-----	20
		Unfavorable	3,000	Indiangrass-----	10
				Switchgrass-----	10
				Sideoats grama-----	5
Go----- Goessel	Clay Upland-----	Favorable	5,000	Big bluestem-----	30
		Normal	3,500	Little bluestem-----	15
		Unfavorable	3,000	Switchgrass-----	10
				Indiangrass-----	5
				Sideoats grama-----	5
				Tall dropseed-----	5
Ho----- Hord	Loamy Terrace-----	Favorable	5,500	Big bluestem-----	30
		Normal	4,500	Little bluestem-----	10
		Unfavorable	3,000	Switchgrass-----	10
				Indiangrass-----	5
				Sideoats grama-----	5
				Tall dropseed-----	5
				Western wheatgrass-----	5
Ir----- Irwin	Clay Upland-----	Favorable	5,000	Big bluestem-----	25
		Normal	3,500	Little bluestem-----	20
		Unfavorable	2,000	Switchgrass-----	15
				Indiangrass-----	15
				Tall dropseed-----	5
				Sideoats grama-----	5

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition		
		Kind of year	Dry				
			weight				
			Lb/acre		Pct		
La----- Ladysmith	Clay Upland-----	Favorable	5,000	Big bluestem-----	25		
		Normal	3,500	Little bluestem-----	20		
		Unfavorable	2,000	Indiangrass-----	15		
				Switchgrass-----	15		
				Tall dropseed-----	5		
				Sideoats grama-----	5		
Ld*: Ladysmith-----	Clay Upland-----	Favorable	6,000	Big bluestem-----	25		
		Normal	4,000	Little bluestem-----	20		
		Unfavorable	2,000	Indiangrass-----	15		
				Switchgrass-----	15		
						Tall dropseed-----	5
						Sideoats grama-----	5
Drummond-----	Saline Lowland-----	Favorable	7,000	Prairie cordgrass-----	30		
		Normal	5,800	Switchgrass-----	10		
		Unfavorable	5,000	Indiangrass-----	10		
				Inland saltgrass-----	10		
						Little bluestem-----	5
						Western wheatgrass-----	5
						Alkali sacaton-----	5
						Sunflower-----	5
						Sedge-----	5
Le----- Lancaster	Loamy Upland-----	Favorable	5,000	Big bluestem-----	30		
		Normal	3,500	Little bluestem-----	25		
		Unfavorable	2,000	Indiangrass-----	10		
				Switchgrass-----	10		
				Sideoats grama-----	5		
Lh*: Lancaster-----	Loamy Upland-----	Favorable	5,000	Big bluestem-----	30		
		Normal	3,500	Little bluestem-----	25		
		Unfavorable	2,000	Indiangrass-----	10		
				Switchgrass-----	10		
						Sideoats grama-----	5
Hedville-----	Shallow Sandstone-----	Favorable	4,000	Little bluestem-----	35		
		Normal	3,000	Big bluestem-----	30		
		Unfavorable	2,000	Switchgrass-----	5		
				Indiangrass-----	5		
						Sideoats grama-----	5
Ln, Lo----- Longford	Loamy Upland-----	Favorable	5,500	Big bluestem-----	25		
		Normal	4,000	Little bluestem-----	20		
		Unfavorable	3,000	Indiangrass-----	10		
				Switchgrass-----	10		
						Sideoats grama-----	5
						Tall dropseed-----	5
Mc----- McCook	Sandy Terrace-----	Favorable	5,000	Big bluestem-----	25		
		Normal	3,600	Little bluestem-----	15		
		Unfavorable	2,800	Switchgrass-----	10		
				Indiangrass-----	10		
						Western wheatgrass-----	10
				Sideoats grama-----	5		

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Nw----- New Cambria	Clay Terrace-----	Favorable	5,000	Big bluestem-----	30
		Normal	4,000	Little bluestem-----	15
		Unfavorable	2,500	Indiangrass-----	10
				Switchgrass-----	10
				Western wheatgrass-----	10
				Sideoats grama-----	5
Tall dropseed-----	5				
Pa----- Plevna	Subirrigated-----	Favorable	9,000	Big bluestem-----	25
		Normal	8,000	Indiangrass-----	15
		Unfavorable	7,000	Prairie cordgrass-----	10
				Switchgrass-----	10
				Eastern gamagrass-----	10
				Little bluestem-----	5
Sedge-----	5				
Pr----- Pratt	Sands-----	Favorable	4,500	Sand bluestem-----	25
		Normal	3,500	Little bluestem-----	20
		Unfavorable	2,500	Indiangrass-----	10
				Sand lovegrass-----	10
				Switchgrass-----	5
				Blue grama-----	5
Sand dropseed-----	5				
Ro----- Roxbury	Loamy Terrace-----	Favorable	5,500	Big bluestem-----	35
		Normal	4,500	Sideoats grama-----	15
		Unfavorable	3,000	Western wheatgrass-----	15
				Switchgrass-----	10
				Little bluestem-----	10
				Indiangrass-----	5
Sm----- Smolan	Loamy Upland-----	Favorable	5,500	Big bluestem-----	25
		Normal	4,000	Little bluestem-----	20
		Unfavorable	3,000	Indiangrass-----	10
				Switchgrass-----	10
				Sideoats grama-----	5
				Tall dropseed-----	5
Western wheatgrass-----	5				
To----- Tobin	Loamy Lowland-----	Favorable	6,000	Big bluestem-----	40
		Normal	5,000	Indiangrass-----	10
		Unfavorable	4,000	Switchgrass-----	10
				Little bluestem-----	5
				Western wheatgrass-----	5
				Sedge-----	5
Prairie cordgrass-----	5				
Eastern gamagrass-----	5				
Wb, Wc----- Wells	Loamy Upland-----	Favorable	5,500	Big bluestem-----	25
		Normal	4,000	Little bluestem-----	20
		Unfavorable	3,000	Indiangrass-----	10
				Switchgrass-----	10
				Sideoats grama-----	5
				Tall dropseed-----	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 heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
At----- Attica	Lilac, American plum.	Common chokecherry	Eastern redcedar, Russian mulberry, ponderosa pine, Scotch pine, honeylocust, Austrian pine, green ash, hackberry.	Siberian elm-----	---
Br----- Bridgeport	American plum-----	Siberian peashrub, lilac.	Eastern redcedar, Russian-olive, Austrian pine, green ash, ponderosa pine, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Ca----- Carwile	---	Amur honeysuckle, American plum, lilac.	Austrian pine, ponderosa pine, osageorange, eastern redcedar, green ash.	Honeylocust-----	Eastern cottonwood.
Cb----- Cass	American plum-----	Amur honeysuckle, lilac.	Eastern redcedar, ponderosa pine, Russian-olive, Austrian pine, green ash, Russian mulberry.	Honeylocust, hackberry.	Eastern cottonwood.
Ce, Cm----- Clime	Fragrant sumac, Tatarian honeysuckle.	Siberian peashrub	Eastern redcedar, green ash, osageorange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm-----	---
Cr, Cs, Ct----- Crete	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Siberian peashrub.	Eastern redcedar, hackberry, Russian-olive, green ash, Austrian pine.	Honeylocust, Siberian elm.	---
De----- Detroit	Amur honeysuckle, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, hackberry, Rocky Mountain juniper.	Austrian pine, Russian-olive, green ash, honeylocust, Russian mulberry.	Siberian elm-----	---
Dr----- Drummond	Silver buffalo-berry, Tatarian honeysuckle, lilac.	Eastern redcedar, Rocky Mountain juniper, Russian-olive, Siberian peashrub.	Green willow, green ash, Siberian elm.	---	Eastern cottonwood.
Ed, Ee----- Edalgo	Siberian peashrub, Amur honeysuckle, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper, hackberry,	Austrian pine, honeylocust, Russian-olive, green ash, Russian mulberry.	Siberian elm-----	---
Fa----- Farnum	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, Austrian pine, hackberry, honeylocust, bur oak, green ash, Russian-olive.	Siberian elm-----	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ge----- Geary	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, hackberry, bur oak, green ash, Russian-olive, Austrian pine, honeylocust.	Siberian elm-----	---
Go----- Goessel	Lilac, Amur honeysuckle, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, Manchurian crabapple.	Austrian pine, green ash, honeylocust, hackberry, Russian-olive.	Siberian elm-----	---
Ho----- Hord	American plum-----	Lilac, Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, Austrian pine, green ash, Russian mulberry, Russian-olive.	Honeylocust, hackberry.	Eastern cottonwood.
Ir----- Irwin	Peking cotoneaster, lilac, Siberian peashrub, Amur honeysuckle.	Eastern redcedar, Manchurian crabapple.	Hackberry, green ash, Russian-olive, Austrian pine, honeylocust.	Siberian elm-----	---
La----- Ladysmith	Lilac, Peking cotoneaster.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian-olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Ld*: Ladysmith-----	Lilac, Peking cotoneaster.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian-olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Drummond-----	Silver buffalo-berry, Tatarian honeysuckle, lilac.	Eastern redcedar, Rocky Mountain juniper, Russian-olive, Siberian peashrub.	Green willow, green ash, Siberian elm.	---	Eastern cottonwood.
Le----- Lancaster	Fragrant sumac, lilac, Siberian peashrub.	Rocky Mountain juniper, Russian mulberry, Russian-olive.	Eastern redcedar, green ash, Austrian pine, bur oak, honeylocust.	Siberian elm-----	---
Lh*: Lancaster-----	Fragrant sumac, lilac, Siberian peashrub.	Rocky Mountain juniper, Russian mulberry, Russian-olive.	Eastern redcedar, green ash, Austrian pine, bur oak, honeylocust.	Siberian elm-----	---
Hedville.					
Ln, Lo----- Longford	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, green ash, Austrian pine, hackberry, Russian-olive.	Siberian elm-----	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Mc----- McCook	American plum, lilac.	Amur honeysuckle	Eastern redcedar, ponderosa pine, hackberry, green ash, Russian-olive, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
Ns. Ness					
Nw----- New Cambria	---	Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Pa----- Plevna	Gray dogwood, redosier dogwood.	Russian-olive, common chokecherry.	Eastern redcedar, hackberry, Scotch pine, Austrian pine.	Golden willow, silver maple, Russian mulberry.	Eastern cottonwood.
Pr----- Pratt	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine.	---	---
Ro----- Roxbury	---	Siberian peashrub, Tatarian honeysuckle, silver buffaloberry.	Russian mulberry, ponderosa pine, green ash, Russian-olive, eastern redcedar.	Hackberry, Siberian elm, honeylocust.	Eastern cottonwood.
Sm----- Smolan	Lilac-----	Amur honeysuckle, Peking cotoneaster, Siberian peashrub, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian-olive, green ash, hackberry.	Siberian elm, honeylocust.	---
To----- Tobin	American plum-----	Lilac, Amur honeysuckle.	Eastern redcedar, Russian-olive, Austrian pine, green ash, ponderosa pine, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Wb, Wc----- Wells	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, hackberry, Russian-olive, honeylocust, bur oak, Austrian pine, green ash.	Siberian elm-----	---

* 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"]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
At----- Attica	Slight-----	Slight-----	Moderate: slope.	Slight.
Br----- Bridgeport	Severe: flooding.	Slight-----	Slight-----	Slight.
Ca----- Carwile	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Cb----- Cass	Severe: flooding.	Slight-----	Slight-----	Slight.
Ce, Cm----- Clime	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
Cr----- Crete	Slight-----	Slight-----	Slight-----	Slight.
Cs, Ct----- Crete	Slight-----	Slight-----	Moderate: slope.	Slight.
De----- Detroit	Severe: flooding.	Slight-----	Slight-----	Severe: erodes easily.
Dr----- Drummond	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.
Ed, Ee----- Edalgo	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Severe: erodes easily.
Fa----- Farnum	Slight-----	Slight-----	Moderate: slope.	Slight.
Ge----- Geary	Slight-----	Slight-----	Moderate: slope.	Slight.
Go----- Goessel	Moderate: wetness, percs slowly, too clayey.	Moderate: wetness, too clayey, percs slowly.	Moderate: too clayey, wetness.	Moderate: too clayey.
Ho----- Hord	Severe: flooding.	Slight-----	Slight-----	Slight.
Ir----- Irwin	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.
La----- Ladysmith	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.
Ld*: Ladysmith-----	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.
Drummond-----	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Le----- Lancaster	Slight-----	Slight-----	Moderate: slope.	Slight.
Lh*: Lancaster-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Hedville-----	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones.	Slight.
Ln, Lo----- Longford	Slight-----	Slight-----	Moderate: slope.	Slight.
Mc----- McCook	Severe: flooding.	Slight-----	Slight-----	Slight.
Ns----- Ness	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Nw----- New Cambria	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
Pa----- Plevna	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
Pr----- Pratt	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ro----- Roxbury	Severe: flooding.	Slight-----	Slight-----	Slight.
Sm----- Smolan	Slight-----	Slight-----	Moderate: slope.	Slight.
To----- Tobin	Severe: flooding.	Slight-----	Moderate: flooding.	Slight.
Wb, Wc----- Wells	Slight-----	Slight-----	Moderate: slope.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[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 herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
At----- Attica	Fair	Fair	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Br----- Bridgeport	Good	Good	Good	Good	Poor	Poor	Good	Poor	Fair.
Ca----- Carwile	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good.
Cb----- Cass	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Ce, Cm----- Clime	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Cr, Cs----- Crete	Good	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Good.
Ct----- Crete	Fair	Good	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
De----- Detroit	Good	Good	Good	Good	Good	Good	Good	Good	Good.
Dr----- Drummond	Poor	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Poor.
Ed, Ee----- Edalgo	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Fa----- Farnum	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Ge----- Geary	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Go----- Goessel	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Poor	Fair.
Ho----- Hord	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Ir----- Irwin	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
La----- Ladysmith	Fair	Good	Good	Good	Poor	Fair	Good	Poor	Good.
Ld*: Ladysmith----- Drummond-----	Fair Poor	Good Fair	Good Fair	Good Poor	Poor Fair	Fair Fair	Good Fair	Poor Fair	Good. Poor.
Le----- Lancaster	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Lh*: Lancaster----- Hedville-----	Fair Very poor	Good Poor	Fair Poor	Fair Poor	Very poor Very poor	Very poor Very poor	Fair Poor	Very poor Very poor	Fair. Poor.
Ln, Lo----- Longford	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Mc----- McCook	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Ns----- Ness	Poor	Poor	Poor	Poor	Fair	Good	Poor	Good	Poor.
Nw----- New Cambria	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
Pa----- Plevna	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
Pr----- Pratt	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Ro----- Roxbury	Good	Good	Good	Fair	Poor	Fair	Good	Poor	Fair.
Sm----- Smolan	Good	Good	Fair	Fair	Poor	Fair	Good	Poor	Fair.
To----- Tobin	Good	Good	Good	Fair	Poor	Fair	Good	Poor	Fair.
Wb, Wc----- Wells	Good	Good	Good	Fair	Very poor	Very poor	Good	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"]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
At----- Attica	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
Br----- Bridgeport	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Ca----- Carwile	Severe: ponding.	Severe: shrink-swell, ponding.	Severe: shrink-swell, ponding.	Severe: shrink-swell, ponding.	Severe: low strength, shrink-swell, ponding.
Cb----- Cass	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
Ce----- Clime	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Cm----- Clime	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cr, Cs, Ct----- Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
De----- Detroit	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Dr----- Drummond	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Ed, Ee----- Edalgo	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Fa----- Farnum	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Ge----- Geary	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Go----- Goessel	Severe: cutbanks cave, wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Ho----- Hord	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Ir----- Irwin	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
La----- Ladysmith	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

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
Ld*: Ladysmith-----	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Drummond-----	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Le----- Lancaster	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
Lh*: Lancaster-----	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, frost action.
Hedville-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Ln, Lo----- Longford	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Mc----- McCook	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
Ns----- Ness	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: low strength, ponding.
Nw----- New Cambria	Moderate: too clayey.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.
Pa----- Plevna	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.
Pr----- Pratt	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Ro----- Roxbury	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Sm----- Smolan	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
To----- Tobin	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Wb----- Wells	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Wc----- Wells	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, 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," "moderate," "good," "fair," and other terms]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
At----- Attica	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Br----- Bridgeport	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Ca----- Carwile	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: ponding, too clayey, hard to pack.
Cb----- Cass	Moderate: flooding.	Severe: seepage, flooding.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
Ce, Cm----- Clime	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Cr----- Crete	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight-----	Poor: hard to pack.
Cs, Ct----- Crete	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Poor: hard to pack.
De----- Detroit	Severe: percs slowly.	Slight-----	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Dr----- Drummond	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness, too clayey, excess sodium.	Severe: wetness.	Poor: too clayey, hard to pack, excess sodium.
Ed, Ee----- Edalgo	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Fa----- Farnum	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Ge----- Geary	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Go----- Goessel	Severe: wetness, percs slowly.	Slight-----	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Ho----- Hord	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Ir----- Irwin	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
La----- Ladysmith	Severe: wetness, percs slowly.	Slight-----	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.

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
Ld*: Ladysmith-----	Severe: wetness, percs slowly.	Slight-----	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Drummond-----	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness, too clayey, excess sodium.	Severe: wetness.	Poor: too clayey, hard to pack, excess sodium.
Le----- Lancaster	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Lh*: Lancaster-----	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Hedville-----	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Ln, Lo----- Longford	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
Mc----- McCook	Moderate: flooding.	Severe: seepage, flooding.	Moderate: flooding.	Severe: seepage.	Good.
Ns----- Ness	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
Nw----- New Cambria	Severe: percs slowly.	Slight-----	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
Pa----- Plevna	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.
Pr----- Pratt	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Ro----- Roxbury	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Sm----- Smolan	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
To----- Tobin	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Wb, Wc----- Wells	Slight-----	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.

* 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," "poor," "probable," and "improbable"]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
At----- Attica	Good-----	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Br----- Bridgeport	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ca----- Carwile	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Cb----- Cass	Good-----	Probable-----	Improbable: too sandy.	Good.
Ce, Cm----- Clime	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Cr, Cs, Ct----- Crete	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
De----- Detroit	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Dr----- Drummond	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Ed, Ee----- Edalgo	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Fa----- Farnum	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
Ge----- Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Go----- Goessel	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ho----- Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ir----- Irwin	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
La----- Ladysmith	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Ld*: Ladysmith-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Drummond-----	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Le----- Lancaster	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Lh*: Lancaster-----	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Hedville-----	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Ln, Lo----- Longford	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Mc----- McCook	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
Ns----- Ness	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Nw----- New Cambria	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Pa----- Plevna	Poor: wetness.	Probable-----	Improbable: too sandy.	Poor: wetness.
Pr----- Pratt	Good-----	Probable-----	Improbable: too sandy.	Fair: too sandy, slope.
Ro----- Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Sm----- Smolan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
To----- Tobin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Wb, Wc----- Wells	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.

* 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"]

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
At----- Attica	Severe: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing, slope.	Soil blowing---	Favorable.
Br----- Bridgeport	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable-----	Erodes easily	Erodes easily.
Ca----- Carwile	Moderate: seepage.	Severe: ponding.	Percs slowly, ponding.	Ponding, erodes easily, soil blowing.	Erodes easily, ponding, soil blowing.	Percs slowly, wetness, erodes easily.
Cb----- Cass	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing---	Soil blowing---	Favorable.
Ce----- Clime	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Cm----- Clime	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Cr, Cs----- Crete	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Ct----- Crete	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily	Erodes easily, percs slowly.
De----- Detroit	Slight-----	Severe: piping.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Dr----- Drummond	Slight-----	Severe: excess sodium.	Percs slowly, excess sodium.	Wetness, droughty.	Erodes easily, wetness.	Excess sodium, erodes easily, droughty.
Ed, Ee----- Edalgo	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Fa----- Farnum	Moderate: seepage.	Severe: thin layer.	Deep to water	Favorable-----	Favorable-----	Favorable.
Ge----- Geary	Moderate: seepage.	Slight-----	Deep to water	Favorable-----	Erodes easily	Erodes easily.
Go----- Goessel	Slight-----	Severe: hard to pack.	Percs slowly---	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Percs slowly.
Ho----- Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable-----	Favorable-----	Favorable.
Ir----- Irwin	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
La----- Ladysmith	Slight-----	Severe: hard to pack.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
Ld*: Ladysmith	Slight-----	Severe: hard to pack.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ld*: Drummond-----	Slight-----	Severe: excess sodium.	Percs slowly, excess sodium.	Wetness, droughty.	Erodes easily, wetness.	Excess sodium, erodes easily, droughty.
Le----- Lancaster	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Lh*: Lancaster-----	Severe: slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Hedville-----	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Ln, Lo----- Longford	Moderate: slope.	Moderate: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Mc----- McCook	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing---	Erodes easily, soil blowing.	Erodes easily.
Ns----- Ness	Moderate: seepage.	Severe: piping, hard to pack, ponding.	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Nw----- New Cambria	Slight-----	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
Pa----- Plevna	Severe: seepage.	Severe: piping, wetness.	Flooding-----	Wetness, soil blowing.	Wetness, soil blowing.	Wetness.
Pr----- Pratt	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Ro----- Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable-----	Erodes easily	Erodes easily.
Sm----- Smolan	Slight-----	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
To----- Tobin	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding-----	Favorable-----	Favorable.
Wb----- Wells	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable-----	Favorable-----	Favorable.
Wc----- Wells	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope-----	Favorable-----	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

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	
Ee----- Edalgo	0-8	Silty clay loam	CL	A-6, A-7-6	0	100	100	90-100	70-95	25-45	11-25
	8-23	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	85-95	45-70	20-40
	23	Weathered bedrock	---	---	---	---	---	---	---	---	---
Fa----- Farnum	0-12	Loam-----	CL-ML, CL	A-4, A-6	0	100	100	90-100	60-85	20-35	5-15
	12-49	Clay loam, sandy clay loam.	SC, CL	A-6, A-7-6	0	100	100	70-100	45-80	35-50	15-30
	49-60	Loam, clay loam, fine sandy loam.	SC, CL, SM-SC, CL-ML	A-6, A-2, A-4	0	100	95-100	65-100	30-80	20-35	5-15
Ge----- Geary	0-10	Silt loam-----	ML, CL	A-4, A-6	0	100	100	96-100	80-98	25-40	2-15
	10-39	Silty clay loam, clay loam.	CL	A-7-6, A-6	0	100	100	96-100	85-98	35-50	15-25
	39-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7-6	0	100	100	96-100	85-98	30-45	11-22
Go----- Goessel	0-14	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
	14-50	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	50-75	30-50
	50-60	Silty clay, clay, clay loam.	CH, CL	A-7	0	100	100	85-100	80-100	40-60	20-35
Ho----- Hord	0-6	Silt loam-----	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	3-18
	6-43	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	98-100	85-100	25-40	8-23
	43-60	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
Ir----- Irwin	0-11	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	90-100	30-45	11-25
	11-42	Silty clay, clay Unweathered bedrock.	CH ---	A-7 ---	0 ---	100 ---	100 ---	95-100 ---	90-100 ---	50-65 ---	25-40 ---
La----- Ladysmith	0-8	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	90-100	30-45	10-25
	8-48	Silty clay, clay	CH	A-7	0	100	100	95-100	90-100	50-65	30-45
	48-60	Silty clay, silty clay loam, clay.	CL, CH	A-7	0	100	100	95-100	90-100	40-65	20-40
Ld*: Ladysmith	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
	8-48	Silty clay, clay	CH	A-7-6	0	100	100	95-100	90-100	50-65	30-45
	48-60	Silty clay, silty clay loam, clay.	CL, CH	A-7-6	0	100	100	95-100	90-100	40-65	20-40
Drummond	0-7	Loam-----	CL, ML, CL-ML	A-4, A-6	0	100	100	96-100	65-97	22-39	3-15
	7-60	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-98	35-60	15-35
Le----- Lancaster	0-10	Loam-----	CL-ML, CL	A-4, A-6	0	100	100	85-100	50-85	20-35	5-15
	10-32	Sandy clay loam, clay loam, loam.	CL, SC	A-4, A-6, A-7-6	0	100	100	80-95	40-65	25-45	8-25
	32	Weathered bedrock	---	---	---	---	---	---	---	---	---
Lh*: Lancaster	0-10	Loam-----	CL-ML, CL	A-4, A-6	0	100	100	85-100	50-85	20-35	5-15
	10-32	Sandy clay loam, clay loam, loam.	CL, SC	A-4, A-6, A-7-6	0	100	100	80-95	40-65	25-45	8-25
	32	Weathered bedrock	---	---	---	---	---	---	---	---	---
Hedville	0-15	Loam-----	SM, ML, SC, CL	A-4, A-6	0-15	70-100	70-100	50-85	35-70	<35	NP-13
	15	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	
Ln, Lo----- Longford	0-15	Silty clay loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	75-95	25-40	5-20
	15-47	Silty clay loam, silty clay, clay loam.	CH, CL	A-7-6	0	100	100	95-100	85-100	40-60	20-35
	47-60	Clay loam, silty clay loam, loam.	CL	A-6, A-7-6	0	100	100	95-100	70-95	30-45	10-25
Mc----- McCook	0-14	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	100	70-85	35-55	<20	NP-5
	14-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	55-100	<20	NP-10
Ns----- Ness	0-60	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
Nw----- New Cambria	0-12	Silty clay-----	CH	A-7	0	100	100	95-100	90-100	50-75	30-45
	12-60	Silty clay, silty clay loam, clay.	CH	A-7	0	100	100	95-100	85-100	50-75	25-45
Pa----- Plevna	0-18	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	20-50	<26	NP-6
	18-36	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	30-50	<26	NP-6
	36-60	Fine sand, sand, loamy fine sand.	SM, SP	A-2, A-3	0	100	90-100	50-90	4-35	---	NP
Pr----- Pratt	0-11	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	11-36	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	36-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Ro----- Roxbury	0-21	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	65-100	35-50	15-25
	21-50	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	80-100	30-50	8-25
	50-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7-6	0	100	100	95-100	65-100	30-50	7-25
Sm----- Smolan	0-11	Silty clay loam	CL	A-7-6, A-6	0	100	100	95-100	85-100	30-45	10-25
	11-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	40-60	20-40
To----- Tobin	0-39	Silt loam-----	CL	A-4, A-6	0	100	100	95-100	90-100	25-40	8-20
	39-60	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	90-100	25-45	8-20
Wb, Wc----- Wells	0-11	Loam-----	CL-ML, CL	A-4, A-6	0	100	100	95-100	65-85	20-30	5-15
	11-49	Clay loam, sandy clay loam.	SC, CL	A-4, A-6, A-7-6	0	100	100	80-100	40-85	30-50	8-25
	49-60	Clay loam, sandy clay loam, sandy loam.	SC, CL, ML, SM	A-4, A-6	0	100	100	80-100	35-85	20-40	NP-15

* 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. 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	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	G/cm ³	In/hr	In/in	pH	Mmhos/cm					Pct
At----- Attica	0-10	2-10	1.50-1.60	2.0-6.0	0.10-0.13	5.6-7.3	<2	Low-----	0.17	5	2	.5-1
	10-25	8-18	1.50-1.60	2.0-6.0	0.12-0.17	5.6-6.5	<2	Low-----	0.24			
	25-60	4-18	1.50-1.60	2.0-6.0	0.08-0.16	6.1-7.8	<2	Low-----	0.24			
Br----- Bridgeport	0-14	18-27	1.30-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low-----	0.32	5	4L	1-4
	14-60	18-30	1.35-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-----	0.43			
Ca----- Carwile	0-16	5-18	1.30-1.65	0.6-2.0	0.11-0.20	5.1-7.3	<2	Low-----	0.24	5	3	1-3
	16-21	25-40	1.45-1.75	0.2-2.0	0.12-0.20	5.1-7.3	<2	Moderate	0.37			
	21-45	35-60	1.35-1.75	0.06-0.2	0.12-0.20	6.1-8.4	<2	High-----	0.37			
	45-60	20-45	1.35-1.75	0.2-2.0	0.12-0.20	6.6-8.4	<2	High-----	0.32			
Cb----- Cass	0-7	7-17	1.40-1.60	2.0-6.0	0.16-0.18	5.6-7.3	<2	Low-----	0.20	5	3	1-2
	7-51	5-15	1.40-1.60	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-----	0.20			
	51-60	2-10	1.50-1.70	6.0-20	0.08-0.10	6.1-8.4	<2	Low-----	0.20			
Ce, Cm----- Clime	0-9	40-50	1.35-1.45	0.06-0.2	0.12-0.14	7.4-8.4	<2	Moderate	0.28	3	4	1-4
	9-27	35-50	1.35-1.50	0.06-0.6	0.12-0.18	7.9-8.4	<2	Moderate	0.28			
Cr, Cs----- Crete	0-6	20-27	1.20-1.40	0.6-2.0	0.22-0.24	5.6-6.0	<2	Moderate	0.37	4	6	2-4
	6-43	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.3	<2	High-----	0.37			
	43-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High-----	0.37			
Ct----- Crete	0-6	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.0	<2	High-----	0.37	4	7	2-4
	6-35	42-52	1.10-1.30	0.06-0.6	0.12-0.20	6.1-7.3	<2	High-----	0.37			
	35-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High-----	0.37			
De----- Detroit	0-13	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
	13-40	35-45	1.35-1.50	0.06-0.2	0.12-0.15	6.6-7.8	<2	High-----	0.37			
	40-60	18-35	1.30-1.50	0.2-0.6	0.18-0.20	6.6-7.8	<2	Moderate	0.37			
Dr----- Drummond	0-7	20-30	1.35-1.55	0.6-2.0	0.11-0.18	6.1-8.4	<4	Low-----	0.43	3	6	1-2
	7-60	35-60	1.40-1.65	<0.06	0.09-0.17	7.4-9.0	2-8	High-----	0.55			
Ed----- Edalgo	0-6	15-27	1.30-1.40	0.6-2.0	0.18-0.24	5.6-7.3	<2	Low-----	0.37	3	6	2-4
	6-15	28-37	1.35-1.50	0.06-0.6	0.10-0.22	5.6-7.3	<2	Moderate	0.37			
	15-30	35-52	1.40-1.60	<0.06	0.10-0.18	5.6-7.8	<2	High-----	0.37			
Ee----- Edalgo	0-8	28-37	1.30-1.40	0.06-0.6	0.18-0.22	5.6-7.3	<2	Moderate	0.37	3	7	1-2
	8-23	35-52	1.40-1.60	<0.06	0.10-0.18	5.6-7.8	<2	High-----	0.37			
Fa----- Farnum	0-12	14-29	1.35-1.45	0.6-2.0	0.19-0.22	5.6-7.3	<2	Low-----	0.28	5	6	1-3
	12-49	25-35	1.40-1.50	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.28			
	49-60	12-29	1.40-1.55	0.6-2.0	0.13-0.16	6.6-8.4	<2	Low-----	0.28			
Ge----- Geary	0-10	15-27	1.30-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low-----	0.32	5	6	1-4
	10-39	27-35	1.35-1.50	0.6-2.0	0.17-0.20	5.6-7.8	<2	Moderate	0.43			
	39-60	20-32	1.30-1.40	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.43			
Go----- Goessel	0-14	40-55	1.30-1.40	<0.06	0.12-0.16	6.1-7.3	<2	High-----	0.28	5	4	1-4
	14-50	40-55	1.35-1.45	<0.06	0.10-0.15	7.4-8.4	<2	High-----	0.28			
	50-60	30-50	1.40-1.55	<0.06	0.09-0.14	7.9-8.4	<2	High-----	0.28			
Ho----- Hord	0-6	17-27	1.30-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low-----	0.32	5	6	2-4
	6-43	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low-----	0.32			
	43-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-----	0.43			
Ir----- Irwin	0-11	28-35	1.35-1.45	0.2-0.6	0.18-0.23	5.6-7.3	<2	Moderate	0.37	4	7	2-4
	11-42	40-55	1.40-1.50	<0.06	0.10-0.15	5.6-8.4	<2	High-----	0.37			

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		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cm ³	In/hr	In/in	pH	Mmos/cm					Pct
La----- Ladysmith	0-8	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-7.3	<2	Moderate	0.37	4	7	2-4
	8-48	40-55	1.35-1.50	<0.06	0.10-0.15	5.6-7.8	<2	High-----	0.37			
	48-60	35-55	1.40-1.60	0.06-0.6	0.10-0.19	7.4-8.4	<2	Moderate	0.37			
Ld*: Ladysmith-----	0-8	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-7.3	<2	Moderate	0.37	4	7	2-4
	8-48	40-55	1.35-1.50	<0.06	0.10-0.15	5.6-7.8	<2	High-----	0.37			
	48-60	35-55	1.40-1.60	0.06-0.6	0.10-0.19	7.4-8.4	<2	Moderate	0.37			
Drummond-----	0-7	20-30	1.35-1.55	0.6-2.0	0.11-0.18	6.1-8.4	<4	Low-----	0.43	3	6	1-2
	7-60	35-60	1.40-1.65	<0.06	0.09-0.17	7.4-9.0	2-8	High-----	0.55			
Le----- Lancaster	0-10	12-26	1.35-1.45	0.6-2.0	0.17-0.22	5.6-6.5	<2	Low-----	0.28	4	6	2-6
	10-32	18-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	32	---	---	---	---	---	---	---	---			
Lh*: Lancaster-----	0-10	12-26	1.35-1.45	0.6-2.0	0.17-0.22	5.6-6.5	<2	Low-----	0.28	4	6	2-6
	10-32	18-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	32	---	---	---	---	---	---	---	---			
Hedville-----	0-15	8-22	1.35-1.50	0.6-2.0	0.14-0.20	5.6-7.3	<2	Low-----	0.32	2	3	1-4
	15	---	---	---	---	---	---	---	---			
Ln, Lo----- Longford	0-15	15-32	1.30-1.40	0.6-2.0	0.20-0.24	5.6-6.5	<2	Low-----	0.37	5	6	1-4
	15-47	35-45	1.35-1.50	0.06-0.6	0.14-0.20	5.6-7.3	<2	High-----	0.37			
	47-60	20-35	1.30-1.40	0.2-0.6	0.15-0.20	6.1-7.8	<2	Moderate	0.37			
Mc----- McCook	0-14	10-17	1.40-1.60	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low-----	0.24	5	3	1-2
	14-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-----	0.43			
Ns----- Ness	0-60	40-60	1.30-1.45	<0.06	0.11-0.14	6.1-7.4	<2	High-----	0.28	5	4	1-3
Nw----- New Cambria	0-12	40-60	1.30-1.40	0.06-0.2	0.12-0.14	6.6-8.4	<2	High-----	0.28	5	4	2-4
	12-60	38-60	1.35-1.45	0.06-0.2	0.13-0.18	7.9-8.4	<2	High-----	0.28			
Pa----- Plevna	0-18	8-18	1.40-1.50	2.0-6.0	0.14-0.18	6.6-8.4	<2	Low-----	0.20	5	3	2-4
	18-36	8-18	1.40-1.50	2.0-6.0	0.12-0.16	6.6-8.4	<2	Low-----	0.20			
	36-60	1-7	1.50-1.60	2.0-6.0	0.05-0.07	6.6-8.4	<2	Low-----	0.20			
Pr----- Pratt	0-11	2-8	1.40-1.55	6.0-20	0.10-0.13	5.6-7.3	<2	Low-----	0.17	5	2	.5-1
	11-36	4-11	1.45-1.55	6.0-20	0.09-0.12	5.6-7.3	<2	Low-----	0.17			
	36-60	1-8	1.45-1.60	6.0-20	0.08-0.12	6.1-7.3	<2	Low-----	0.17			
Ro----- Roxbury	0-21	28-35	1.30-1.45	0.6-2.0	0.21-0.23	7.4-8.4	<2	Moderate	0.32	5	4L	2-4
	21-50	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
	50-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Sm----- Smolan	0-11	28-35	1.30-1.40	0.2-0.6	0.21-0.23	5.6-7.3	<2	Moderate	0.37	5	7	2-4
	11-60	35-50	1.30-1.45	0.06-0.2	0.12-0.18	5.6-7.8	<2	High-----	0.37			
To----- Tobin	0-39	18-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.8	<2	Moderate	0.32	5	6	1-4
	39-60	18-35	1.35-1.50	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.32			
Wb, Wc----- Wells	0-11	18-24	1.35-1.50	0.6-2.0	0.20-0.22	5.6-6.5	<2	Low-----	0.28	5	5	1-4
	11-49	25-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	49-60	10-30	1.35-1.60	0.6-2.0	0.12-0.18	6.1-7.8	<2	Low-----	0.28			

* 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," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

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				
At----- Attica	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Br----- Bridgeport	B	Rare-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Ca----- Carwile	D	None-----	---	---	+1-2.0	Apparent	Oct-Apr	>60	---	High-----	High-----	Moderate.
Cb----- Cass	B	Rare-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ce, Cm----- Clime	C	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
Cr, Cs, Ct----- Crete	D	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
De----- Detroit	C	Rare-----	---	---	>6.0	---	---	>60	---	Low-----	High-----	Low.
Dr----- Drummond	D	Rare-----	---	---	2.0-6.0	Apparent	Nov-Apr	>60	---	Moderate	High-----	High.
Ed, Ee----- Edalgo	C	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
Fa----- Farnum	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ge----- Geary	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Low-----	Low.
Go----- Goessel	D	None-----	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	Moderate	High-----	Low.
Ho----- Hord	B	Rare-----	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Ir----- Irwin	D	None-----	---	---	>6.0	---	---	40-60	Soft	Moderate	High-----	Low.
La----- Ladysmith	D	None-----	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	Moderate	High-----	Low.
Ld*: Ladysmith-----	D	None-----	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	Moderate	High-----	Low.
Drummond-----	D	Rare-----	---	---	2.0-6.0	Apparent	Nov-Apr	>60	---	Moderate	High-----	High.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

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
					<u>Ft</u>			<u>In</u>				
Le----- Lancaster	B	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	Low-----	Moderate.
Lh*: Lancaster-----	B	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	Low-----	Moderate.
Hedville-----	D	None-----	---	---	>6.0	---	---	4-20	Hard	Moderate	Low-----	Moderate.
Ln, Lo----- Longford	C	None-----	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Mc----- McCook	B	Rare-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Ns----- Ness	D	None-----	---	---	+1-1.0	Perched	Mar-Jun	>60	---	Moderate	High-----	Low.
Nw----- New Cambria	C	Rare-----	---	---	>6.0	---	---	>60	---	Low-----	High-----	Low.
Pa----- Plevna	D	Frequent---	Brief to long.	Mar-Oct	0-2.0	Apparent	Jan-Dec	>60	---	High-----	High-----	Low.
Pr----- Pratt	A	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Moderate.
Ro----- Roxbury	B	Rare-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Sm----- Smolan	C	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
To----- Tobin	B	Occasional	Very brief	Mar-Dec	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Wb, Wc----- Wells	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Attica-----	Coarse-loamy, mixed, thermic Udic Haplustalfs
Bridgeport-----	Fine-silty, mixed, mesic Fluventic Haplustolls
Carwile-----	Fine, mixed, thermic Typic Argiaquolls
Cass-----	Coarse-loamy, mixed, mesic Fluventic Haplustolls
Clime-----	Fine, mixed, mesic Udorthentic Haplustolls
Crete-----	Fine, montmorillonitic, mesic Pachic Argiustolls
Detroit-----	Fine, montmorillonitic, mesic Pachic Argiustolls
Drummond*	Fine, mixed, thermic Mollic Natrustalfs
Edalgo-----	Fine, mixed, mesic Udic Argiustolls
Farnum-----	Fine-loamy, mixed, thermic Pachic Argiustolls
Geary-----	Fine-silty, mixed, mesic Udic Argiustolls
Goessel-----	Fine, montmorillonitic, mesic Udic Pellusterts
Hedville-----	Loamy, mixed, mesic Lithic Haplustolls
Hord-----	Fine-silty, mixed, mesic Cumulic Haplustolls
Irwin-----	Fine, mixed, mesic Pachic Argiustolls
Ladysmith-----	Fine, montmorillonitic, mesic Pachic Argiustolls
Lancaster-----	Fine-loamy, mixed, mesic Udic Argiustolls
Longford-----	Fine, montmorillonitic, mesic Udic Argiustolls
McCook-----	Coarse-silty, mixed, mesic Fluventic Haplustolls
Ness-----	Fine, montmorillonitic, mesic Udic Pellusterts
New Cambria-----	Fine, montmorillonitic, mesic Cumulic Haplustolls
Plevna-----	Coarse-loamy, mixed, thermic Fluvaquentic Haplaquolls
Pratt-----	Sandy, mixed, thermic Psammentic Haplustalfs
Roxbury-----	Fine-silty, mixed, mesic Cumulic Haplustolls
Smolan-----	Fine, montmorillonitic, mesic Pachic Argiustolls
Tobin-----	Fine-silty, mixed, mesic Cumulic Haplustolls
Wells-----	Fine-loamy, mixed, mesic Udic Argiustolls

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

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