USDA United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with South Dakota Agricultural Experiment Station

Soil Survey of Clark County, South Dakota

How To Use This Soil Survey

General Soil Map

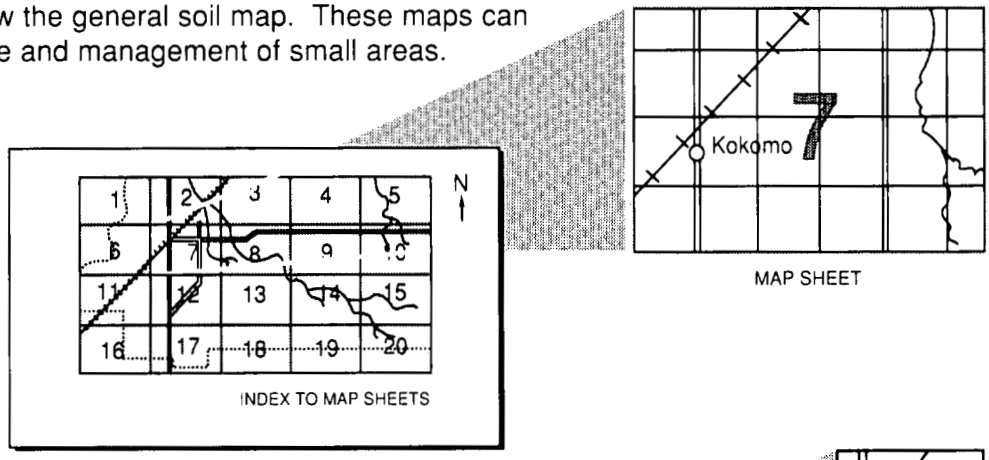
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

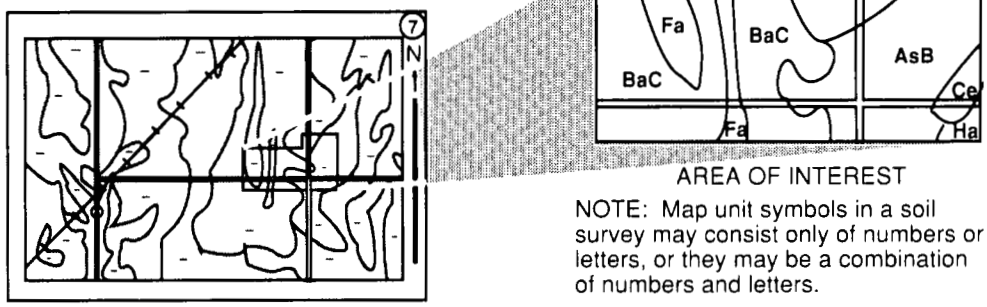
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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 Natural Resources Conservation Service, formerly the Soil Conservation Service, has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1990. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1991. This survey was made cooperatively by the Natural Resources Conservation Service and the South Dakota Agricultural Experiment Station at South Dakota State University. It is part of the technical assistance furnished to the Clark County Conservation District. Some financial assistance was provided by the Clark County Commissioners.

Cover: Potato harvest in an area of Poinsett-Rusklyn-Waubay silty clay loams, 1 to 6 percent slopes.

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Issued 1999

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Foreword

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

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

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too stony for cultivation. 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 Natural Resources Conservation Service or the South Dakota Cooperative Extension Service.

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Soil Survey of
Clark County, South Dakota

By Karl J. Krueger, Natural Resources Conservation Service

Soils surveyed by Scott Anderson, Mark Hauser, James B. Millar, Eugene E. Preston, Kim D. Kempton, Karl J. Krueger, and Loren D. Schultz, Natural Resources Conservation Service, and Arvid C. Melland and Chuck Hammond, Clark County Conservation District

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with the
South Dakota Agricultural Experiment Station at South Dakota State University

CLARK COUNTY is in the northeastern part of South Dakota (fig. 1). It has a total land area of 619,578 acres. In 1990, the population was 4,403 (U.S. Department of Commerce, 1991). Clark, the county seat, had a population of 1,292. Other towns in the county and their population include Bradley, 117; Garden City, 93; Naples, 35; Raymond, 96; Vienna, 93; and Willow Lake, 317.

About 65 percent of the acreage in the county is used as cropland, 8 percent as pasture and hayland, 21 percent as rangeland, and 6 percent for other uses. Wheat, corn, soybeans, oats, barley, and alfalfa are the main crops. Farming is diversified. Livestock and livestock products are the main sources of income, but income from cash crops also is important.

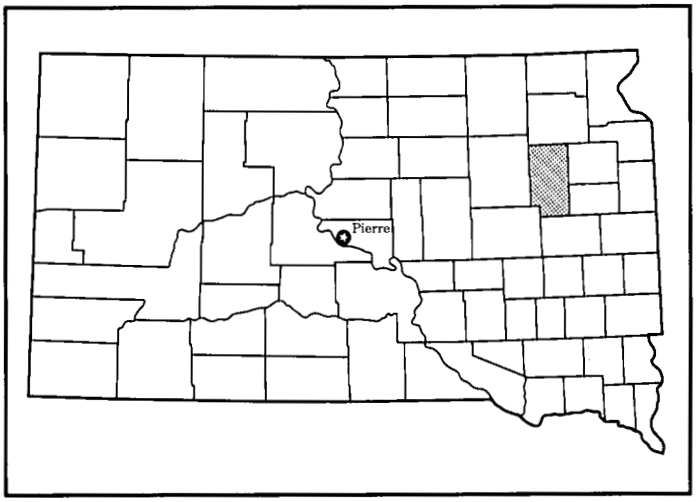

Figure 1.—Location of Clark County in South Dakota.

General Nature of the County

This section gives general information concerning the county. It describes climate; physiography, relief, and drainage; settlement; ranching and farming; and natural resources.

Climate

Clark County is cold in winter and is quite hot with occasional cool spells in summer. Precipitation during the winter frequently occurs as snowstorms, and during the warm months it is chiefly showers, often heavy, when warm moist air moves in from the south. Total annual rainfall is normally adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Clark, South Dakota, for the period 1951 to 1987. 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 15 degrees F and the average daily minimum temperature is 5

degrees. The lowest temperature on record, which occurred at Clark on January 15, 1972, is -35 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred at Clark on July 9, 1976, is 105 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 21 inches. Of this, about 16 inches, or almost 80 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 12 inches. The heaviest 1-day rainfall on record was 3.77 inches at Clark on July 18, 1985. Thunderstorms occur on about 40 days each year.

The average seasonal snowfall is 32 inches. The greatest snow depth at any one time during the period of record was 26 inches. On the average, 46 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south-southeast in summer and from the northwest in winter. Average windspeed is highest, 14 miles per hour, in spring.

Tornadoes and severe thunderstorms strike occasionally. These storms are local and of short duration and result in very severe damage in small, localized areas. Hailstorms occur during the warmer part of the year in irregular patterns and in relatively small areas.

Physiography, Relief, and Drainage

More than half of Clark County is on the Coteau des Prairies (Flint, 1955). This part of the county is gently rolling to undulating. Basins are numerous in this area, and external drainage is nearly nonexistent. The western edge of the Coteau des Prairies trends nearly north-south a few miles west of central Clark County.

The western one-third of the county is in the James Basin physiographic area. Drainage in this area is generally westward to the James River. The area is characterized by small basins, some of which are barely perceptible. It is nearly level, except near drainageways. The drainageways are trenched near their headwaters along the western edge of the Coteau des Prairies.

Most streamflow occurs in 14 short intermittent streams that flow from the western edge of the Coteau des Prairies into the James Basin. Fordham, Foster, Pearl, Redstone, and Shue Creeks are the principal creeks in the county. Most of the flow is in the spring and after heavy rains. The county has about 1,000 lakes, ponds, and marshes. The more significant lakes include Antelope, Bailey's, Cherry, Round, Swan, and Willow Lakes. These lakes are all on the Coteau des Prairies.

Settlement

Clark County was named for Newton Clark, a member of the Dakota Territorial Legislature. The county was established in 1873 and organized in 1881 (Centennial History, 1981). The original county included part of Day County. The present boundaries were established in 1885.

Prior to settlement by European immigrants, different tribes of Indians utilized the natural flora and fauna of the region. The Sioux tribe was the most significant. Tribes north of the region traveled over the Assiniboine Trail, which followed the western edge of the Coteau des Prairies, on their journey to the pipestone quarries in Minnesota.

The first European settlers arrived in 1878 and settled in the area of Bailey's Lake (Centennial History, 1981). Settlement increased rapidly after the railroad was extended to Clark Center (city of Clark) in 1881. The towns of Garden City, Elrod, Bradley, Crocker, Naples, Vienna, Carpenter, and Willow Lake sprang up as the railroads were extended through the county. The population of the county was 6,728 by 1890 and reached its peak of 11,136 in 1920.

Vienna and Willow Lake are the only communities currently served by the railroad. South Dakota Highways 20, 25, and 28 and U.S. Highway 212 are the main highways. Most rural areas are served by all-weather roads and by a network of secondary roads that is adequate for travel. A small airport is located at Clark.

Ranching and Farming

Farming is the principal enterprise in Clark County. About 66 percent of farm income is derived from the sale of livestock and livestock products (U.S. Department of Commerce, 1987). The rest is derived mainly from the sale of small grain and corn. Some of the crops are used as feed for livestock.

In 1987, there were 688 farms in the county (U.S. Department of Commerce, 1987). In general, the trend has been toward fewer and larger farms, but the number of farms increased slightly between 1982 and 1987.

About 73 percent of the acreage is used for cultivated crops or for tame pasture and hay, and about 21 percent is range (USDA, 1987). Dryland farming is dominant. About 6,463 acres was irrigated in 1987 (U.S. Department of Commerce, 1987). Nearly all irrigation water is applied by the sprinkler method.

Wheat, corn, soybeans, oats, barley, and alfalfa are the main cultivated crops. Flax, potatoes, rye, sorghum, and sunflowers are also grown. In 1989, according to the South Dakota Agricultural Statistics Service, wheat was grown on 102,000 acres, corn on 69,200 acres, soybeans on 34,200 acres, oats on 27,000 acres, barley on 10,500 acres, sunflowers on 1,900 acres, rye on 3,700 acres, sorghum on 2,600 acres, and flax on 1,200 acres. According to the Farm Service Agency, 4,696 acres was used for potatoes in 1990.

The Clark County Conservation District was established in 1947 to help farmers control erosion problems. Three townships in the present Clark County Soil and Water Conservation District were included in the Carpenter Soil Conservation District, which was organized in 1941. In April 1961, the Carpenter Soil Conservation District in Clark County was dissolved and added to the Clark County Conservation District. The district has been instrumental in planting trees on hundreds of acres since it was organized.

Natural Resources

Soil is the most important natural resource in Clark County. It provides a growing medium for crops and the grasses grazed by livestock. Other natural resources are water, sand and gravel, and wildlife.

The principal source of water for domestic use and for livestock is shallow wells. Excavated ponds in areas of Oldham, Parnell, Southam, Tetonka, Tonka, and Worthing soils provide additional water for livestock and wildlife. The water from shallow wells is in glacial till or outwash material. About 70 percent of the county is underlain by glacial aquifers. Depth to the aquifers ranges from 1 to 585 feet (Hamilton, 1986). The yields and the quality of water from the wells vary greatly. In general, the glacial aquifers are suitable for human and livestock use. In some cases, however, treatment may be needed for domestic use because of excess iron or manganese and because of hardness. The sodium hazard is low, but high or very high salinity may require careful management if the water is used for irrigation, even if drainage is adequate. The bedrock aquifer that underlies the county yields soft water unsuitable for irrigation because of excess sodium. The water in this aquifer also contains fluoride, which may cause mottling of children's teeth (Hamilton, 1986).

Significant deposits of sand and gravel are in areas of the Sioux-Renshaw and Renshaw-Fordville associations. These associations extend roughly from north to south through the center of the county. Gravel is also in the northeast and northwest corners of the county and, to a lesser extent, in a few other areas.

White-tailed deer and upland game birds, such as ring-necked pheasant, are the major wildlife resources in the county. The numerous potholes and wetlands provide good wildlife production areas. A small herd of antelope inhabits the Crocker Hills area. Coyote and fox are the main predators in the county. Bass, bluegill, crappies, and perch provide fishing opportunities in stock-water impoundments. Walleye, northern pike, and perch inhabit Round Lake and Bailey's Lake.

How This Survey Was Made

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

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

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations,

supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

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

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

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

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

Some of the soil names and delineations in this survey do not coincide exactly with those in the soil surveys of Beadle, Codington, and Spink Counties, which are adjacent to Clark County. Differences are the result of variations in the design and composition of the map units or of changes and refinements in series concepts.

Map Unit Composition

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

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

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the

landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

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

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

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

The soils in the associations are in different landform positions (fig. 2). These different landform positions affect such characteristics as the amount of topsoil, the drainage class, the runoff rate, and the content of organic matter.

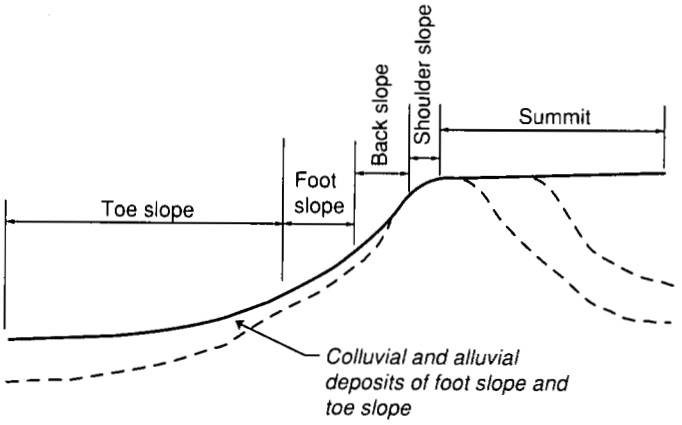

Figure 2.—Landform positions.

Soil Descriptions

Level to Gently Rolling, Loamy and Silty Soils That Are Well Drained and Moderately Well Drained; on Till Plains and Moraines

These soils make up about 15 percent of the county. About 80 percent of the acreage is cropland. Controlling erosion and improving the rate of water infiltration are the main management concerns.

1. Forman-Aastad-Cavour Association

Well drained and moderately well drained, nearly level to gently rolling, loamy soils and moderately well drained, level and nearly level, sodium-affected, loamy soils; on till plains and moraines

This association is characterized by rises interrupted by shallow drainageways. Slopes are mostly nearly level to undulating, but a few areas are gently rolling. The drainage pattern is somewhat poorly defined, except along the larger drainageways, which lead to the west.

This association makes up about 1 percent of the county. It is about 30 percent Forman soils, 25 percent Aastad soils, 20 percent Cavour and similar soils, and 25 percent minor soils.

The well drained Forman soils are on summits and back slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark gray loam. The subsoil is dark grayish brown clay loam in the upper part and grayish brown and light brownish gray, calcareous clay loam in the lower part. The underlying material is light brownish gray, mottled, calcareous clay loam.

The moderately well drained Aastad soils are on foot slopes. Slopes range from 0 to 4 percent. Typically, the surface soil is dark gray loam. The subsoil is dark grayish brown and light olive brown clay loam in the upper part. It is light yellowish brown, calcareous clay loam in the lower part. The underlying material is light olive brown, mottled, calcareous clay loam.

The moderately well drained Cavour soils are on back slopes. Slopes range from 0 to 2 percent. Typically, the surface layer is dark gray loam. The

subsurface layer is gray loam. The upper part of the subsoil is dark grayish brown clay and has masses of salt below a depth of 18 inches. The lower part is light brownish gray, mottled, calcareous clay loam. The underlying material is light brownish gray and pale olive, mottled, calcareous clay loam.

Of minor extent in this association are Buse, Cresbard, Ferney, Fordville, La Prairie, Peever, and Renshaw soils. The well drained Buse soils are on shoulder slopes. They are calcareous at or near the surface. Cresbard soils have a sodium-affected subsoil. They are on back slopes. Ferney soils have a sodium-affected subsoil that is closer to the surface than that in the Cavour soils. They are in positions on the landscape similar to those of the Cavour soils. The well drained Fordville soils have gravelly material at a depth of 20 to 40 inches. They are on foot slopes. The moderately well drained La Prairie soils formed in alluvial deposits along streams and drainageways. Peever soils have more clay in the subsoil than the Forman and Aastad soils. They are on back slopes. The somewhat excessively drained Renshaw soils are on back slopes. They have gravelly material at a depth of 14 to 20 inches.

About 85 percent of this association is cropland. Small grain, corn, soybeans, and alfalfa are the main crops. Controlling erosion is the main management concern. The sodium-affected subsoil and a slow rate of water infiltration in the Cavour soils are also concerns. The soils in this association are suited to cultivated crops, tame pasture and hay, and range.

2. Forman-Cresbard-Cavour Association

Well drained, nearly level to undulating, loamy soils and moderately well drained, level to gently undulating, sodium-affected, loamy soils; on till plains

This association is characterized by predominantly nearly level landscapes with many microbasins. The drainage pattern is poorly defined, except along a few of the larger drainageways.

This association makes up about 9 percent of the county. It is about 40 percent Forman and similar soils, 25 percent Cresbard soils, 15 percent Cavour and similar soils, and 20 percent minor soils.

The well drained Forman soils are on summits and back slopes. Slopes generally range from 0 to 6 percent, but in a few areas they range from 0 to 9 percent. Typically, the surface layer is dark gray loam. The subsoil is dark grayish brown clay loam in the upper part and grayish brown and light brownish gray, calcareous clay loam in the lower part. The underlying material is light brownish gray, mottled, calcareous clay loam.

The moderately well drained Cresbard soils are on summits and back slopes. Slopes range from 0 to 4 percent. Typically, the surface layer is dark gray loam. The subsurface layer is gray loam. Below this is a transitional layer of gray and dark gray loam. The subsoil is dark gray and grayish brown silty clay in the upper part and grayish brown, mottled, calcareous clay loam in the lower part. The underlying material is light brownish gray, mottled, calcareous clay loam.

The moderately well drained Cavour soils are on foot slopes. Slopes range from 0 to 2 percent. Typically, the surface layer is dark gray loam. The subsurface layer is gray loam. The upper part of the subsoil is dark grayish brown clay and has masses of salt below a depth of 18 inches. The lower part is light brownish gray, mottled, calcareous clay loam. The underlying material is light brownish gray and pale olive, mottled, calcareous clay loam.

Of minor extent in this association are Buse, Ferney, Heil, La Prairie, Ranslo, and Tonka soils. The well drained Buse soils are on shoulder slopes. They are calcareous at or near the surface. Ferney soils have a sodium-affected subsoil that is closer to the surface than that in the Cavour soils. They are on foot slopes. The poorly drained Heil soils are in basins. They have a sodium-affected subsoil. The moderately well drained La Prairie soils are on high flood plains. They are dark to a depth of more than 20 inches. The somewhat poorly drained Ranslo soils are on low flood plains. They have a sodium-affected subsoil. The poorly drained Tonka soils are in basins.

About 85 percent of this association is cropland. The hazard of erosion and the sodium-affected subsoil in the Cresbard and Cavour soils are the main management concerns in cultivated areas. The sodium-affected subsoil in the Cresbard and Cavour soils also limits the rate of water infiltration. The main crops are alfalfa, corn, and small grain. The major soils are suited to cultivated crops, tame pasture and hay, and range. Many areas are used as range.

3. Houdek-Stickney-Dudley Association

Well drained and moderately well drained, nearly level to undulating, loamy soils and level and nearly level, sodium-affected, silty soils; on till plains

This association makes up about 3 percent of the county. It is about 30 percent Houdek soils, 20 percent Stickney soils, 15 percent Dudley soils, and 35 percent minor soils.

This association is characterized by predominantly nearly level landscapes with many microbasins. The drainage pattern is poorly defined, except along a

few of the larger drainageways.

The well drained Houdek soils are on summits and back slopes. Slopes range from 0 to 6 percent. Typically, the surface layer is dark gray loam. The subsoil is dark grayish brown clay loam in the upper part and light yellowish brown, calcareous clay loam and loam in the lower part. The underlying material is light brownish gray, mottled, calcareous loam that has nests of gypsum.

The moderately well drained Stickney soils are on summits and back slopes. Slopes range from 0 to 3 percent. Typically, the surface layer is dark gray silt loam. The subsurface layer is gray silt loam. Below this is a thin transitional layer of dark gray and gray silty clay loam. The upper part of the subsoil is dark gray and very dark gray silty clay loam and silty clay. The lower part is pale yellow and light yellowish brown, mottled, calcareous clay loam that has masses of salt. The underlying material is light brownish gray, mottled, calcareous clay loam.

The moderately well drained Dudley soils are on foot slopes. Slopes range from 0 to 2 percent. Typically, the surface layer is dark gray silt loam. The subsurface layer is gray silt loam. The upper part of the subsoil is dark gray and very dark gray clay that has nests of salt below a depth of 28 inches. The next part is light brownish gray, calcareous silty clay. The lower part of the subsoil is light yellowish brown, mottled, calcareous clay loam. The underlying material is olive gray, mottled, calcareous clay loam.

Of minor extent in this association are Bon, Ethan, Hoven, Jerauld, Tetonka, and Worthing soils. The moderately well drained Bon soils are on high flood plains. The well drained Ethan soils are on shoulder slopes. They are calcareous at or near the surface. The poorly drained Hoven and Tetonka soils and the very poorly drained Worthing soils are in basins. Jerauld soils have a sodium-affected subsoil that is closer to the surface than that in the Stickney and Dudley soils. Jerauld soils are on foot slopes.

About 70 percent of this association is cropland. The hazard of erosion and the sodium-affected subsoil in the Stickney and Dudley soils are the main management concerns in cultivated areas. The sodium-affected subsoil in the Stickney and Dudley soils also limits the rate of water infiltration. The main crops are alfalfa, corn, small grain, soybeans, and sunflowers. The major soils are suited to cultivated crops, tame pasture and hay, and range. Many areas are used as range.

4. Beadle-Dudley Association

Well drained, nearly level to moderately sloping, loamy soils and moderately well drained, sodium-affected, silty soils; on till plains and moraines

This association makes up about 1 percent of the county. It is about 40 percent Beadle and similar soils, 20 percent Dudley and similar soils, and 40 percent minor soils.

This association is mainly nearly level and gently sloping, but a few areas are moderately sloping. The drainage pattern is poorly defined, except along a few major drainageways.

The well drained Beadle soils are on summits and back slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is very dark gray loam. The subsoil is dark gray, grayish brown, and light yellowish brown clay loam. It is calcareous in the lower part. The underlying material is light yellowish brown, mottled, calcareous clay loam.

The moderately well drained Dudley soils are on foot slopes. Slopes range from 0 to 2 percent. Typically, the surface layer is dark gray silt loam. The subsurface layer is gray silt loam. The upper part of the subsoil is dark gray and very dark gray clay that has nests of salt below a depth of 28 inches. The next part is light brownish gray, calcareous silty clay. The lower part of the subsoil is light yellowish brown, mottled, calcareous clay loam. The underlying material is olive gray, mottled, calcareous clay loam.

Of minor extent in this association are Clarno, Durrstein, Ethan, Jerauld, and Stickney soils. Clarno soils have less clay than the Beadle soils. They are in positions on the landscape similar to those of the Beadle soils. The poorly drained Durrstein soils are on low flood plains. The well drained Ethan soils are on shoulder slopes. They are calcareous at or near the surface. Jerauld soils are on foot slopes. They have visible salts within a depth of 16 inches. The subsoil of the Stickney soils is less affected by sodium than that of the Dudley soils. Stickney soils are in positions on the landscape similar to those of the Dudley soils.

About 60 percent of this association is cropland. The hazard of erosion, a slow rate of water infiltration, and the sodium-affected subsoil in the Dudley soils are the main management concerns in cultivated areas. The main crops are alfalfa, corn, small grain, soybeans, and sunflowers. The major soils are suited to cultivated crops, tame pasture and hay, and range. Many areas are used as range.

Level to Steep, Loamy and Silty Soils That Are Well Drained to Very Poorly Drained; on Till Plains and Moraines

These soils dominantly are nearly level to moderately sloping, but they are level in basins and steep near large drainageways. They make up about 44 percent of the county. About 70 percent of the acreage is

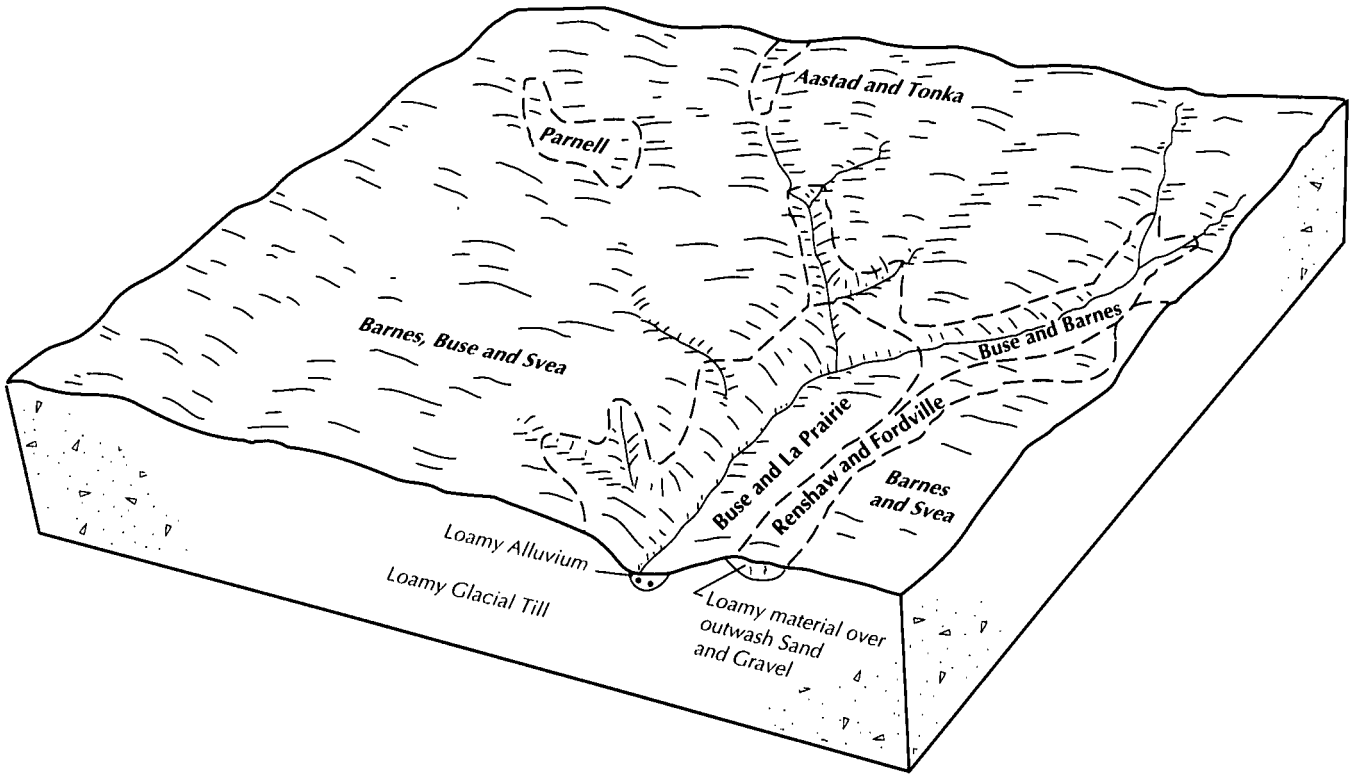

Figure 3.—Typical pattern of soils and underlying material in the Barnes-Svea-Buse association.

cropland. Controlling erosion is the main management concern.

5. Barnes-Svea-Buse Association

Well drained and moderately well drained, nearly level to steep, loamy soils on till plains and moraines

This association is characterized by numerous undulations and small basins. The drainage pattern is mostly well defined. The western part of the association is dissected by entrenched drainageways flowing off the Coteau des Prairies. Scattered stones are on the surface in some areas.

This association makes up about 25 percent of the county. It is about 35 percent Barnes and similar soils, 30 percent Svea and similar soils, 20 percent Buse soils, and 15 percent minor soils (fig. 3).

The well drained Barnes soils are on summits and back slopes. Slopes range from 0 to 25 percent. Typically, the surface layer is very dark gray loam. The subsoil is brown loam in the upper part and light yellowish brown, calcareous clay loam in the lower part. The underlying material is light yellowish brown, mottled, calcareous clay loam.

The moderately well drained Svea soils are on foot slopes. Slopes range from 0 to 4 percent. Typically, the surface soil is very dark gray loam. The subsoil is dark gray and grayish brown loam and clay loam in the upper part. It is light brownish gray, calcareous clay loam and loam in the lower part. It is mottled below a depth of 31 inches. The underlying material is light yellowish brown, mottled, calcareous clay loam.

The well drained Buse soils are on shoulder slopes. Slopes range from 3 to 40 percent. Typically, the surface layer is dark gray, calcareous loam. The subsoil is pale yellow, calcareous loam. The underlying material is pale yellow, mottled, calcareous clay loam.

Of minor extent in this association are Aastad, Fordville, Hamerly, La Prairie, Parnell, Renshaw, and Tonka soils. The moderately well drained Aastad, well drained Fordville, and somewhat poorly drained Hamerly soils are on foot slopes. Aastad soils have more clay in the subsoil than the Svea soils. Fordville soils have gravelly material at a depth of 20 to 40 inches. Hamerly soils are calcareous at or near the surface. The moderately well drained La Prairie soils formed in alluvium on high flood plains. The poorly drained Parnell and Tonka soils are in basins. The

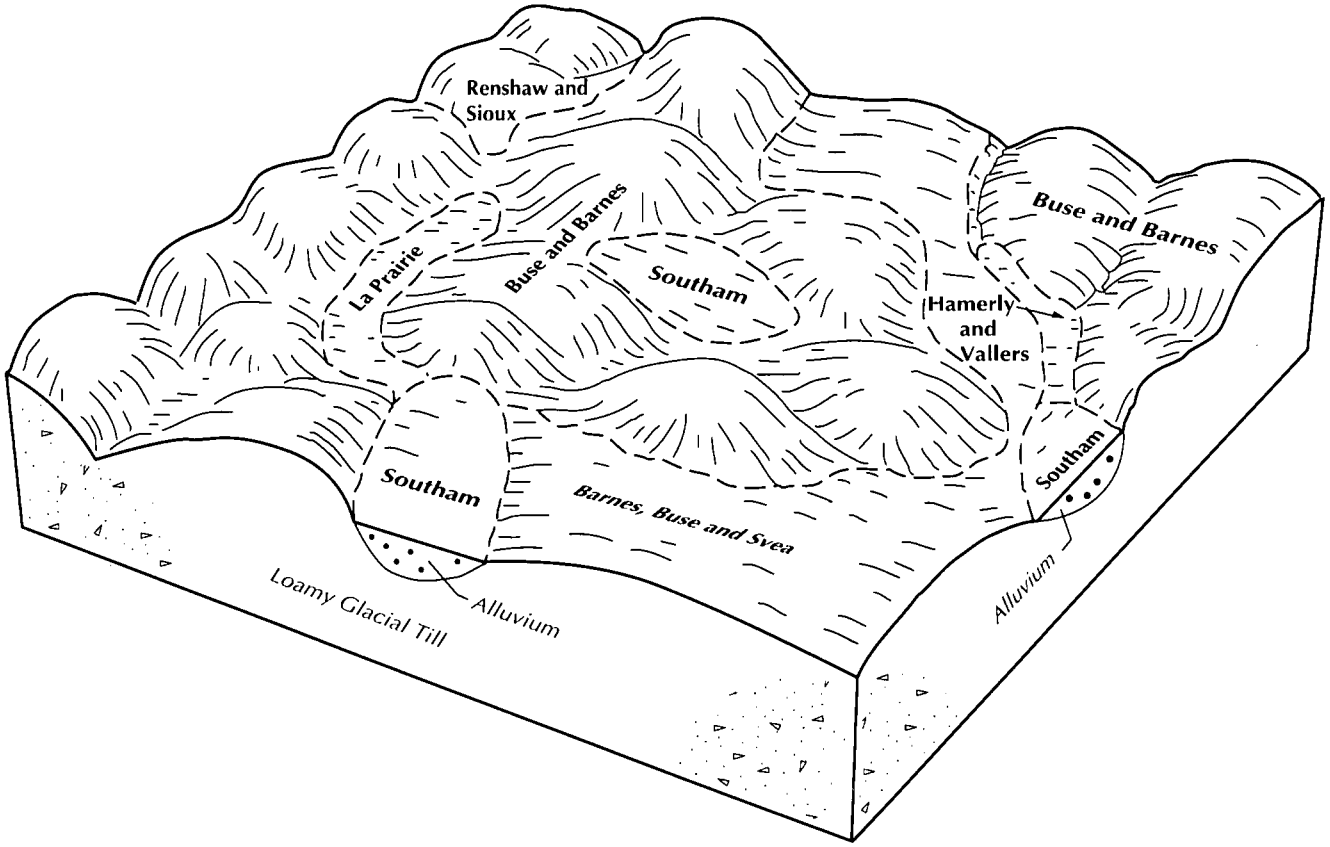

Figure 4.—Typical pattern of soils and underlying material in the Buse-Barnes-Southam association.

somewhat excessively drained Renshaw soils are on back slopes. They have gravelly material at a depth of 14 to 20 inches.

About 65 percent of this association is cropland. Alfalfa, corn, small grain, and soybeans are the main crops. The hazard of erosion and the content of lime in the Buse soils are the main management concerns in cultivated areas. The major soils are suited to cultivated crops, tame pasture and hay, and range. Some areas support native grasses.

6. Buse-Barnes-Southam Association

Well drained and very poorly drained, level to strongly sloping, loamy and silty soils on till plains and moraines

This association is characterized by gently rolling and strongly sloping topography and numerous basins. Slopes in some areas are moderately steep or steep along drainageways or large basins. The drainage pattern is mostly poorly defined. Drainageways terminate in basins. Scattered stones are on the surface in some areas.

This association makes up about 4 percent of the county. It is about 30 percent Buse soils, 30 percent Barnes soils, 15 percent Southam and similar soils, and 25 percent minor soils (fig. 4).

The well drained Buse soils are on shoulder slopes. Slopes generally range from 3 to 15 percent, but in a few places they range from 3 to 40 percent. Typically, the surface layer is dark gray, calcareous loam. The subsoil is pale yellow, calcareous loam. The underlying material is pale yellow, mottled, calcareous clay loam.

The well drained Barnes soils are on summits and back slopes. Slopes generally range from 0 to 15 percent, but in a few places they range from 0 to 25 percent. Typically, the surface layer is very dark gray loam. The subsoil is brown loam in the upper part and light yellowish brown, calcareous clay loam in the lower part. The underlying material is light yellowish brown, mottled, calcareous clay loam.

The very poorly drained Southam soils are in the deeper basins. Slopes are 0 to 1 percent. Typically, the surface layer is gray, calcareous silty clay loam. The subsurface layer is gray, mottled, calcareous silty clay

loam. Below this is a transitional layer of dark gray, calcareous silty clay. The underlying material is dark gray and gray, mottled, calcareous silty clay.

Of minor extent in this association are Fordville, Hamerly, La Prairie, Renshaw, Sioux, Svea, Tonka, and Vallers soils. The well drained Fordville and somewhat poorly drained Hamerly soils are on foot slopes. Fordville soils have gravelly material at a depth of 20 to 40 inches. Hamerly soils are calcareous at or near the surface. The moderately well drained La Prairie soils formed in alluvium on high flood plains. The somewhat excessively drained Renshaw soils are on back slopes. They have gravelly material at a depth of 14 to 20 inches. The excessively drained Sioux soils are on shoulder slopes. They have gravelly material at a depth of 6 to 14 inches. The moderately well drained Svea soils are on foot slopes. The poorly drained Tonka soils are in the smaller basins. The poorly drained Vallers soils are on toe slopes.

About 50 percent of this association supports native grass and is used for grazing. These areas are too steep or too wet for cultivated crops. The less sloping areas of the Barnes soils are suitable for cultivated crops, tame pasture and hay, and range. Alfalfa, corn, and small grain are the main crops. The hazard of erosion and the content of lime in the Buse soils are the main management concerns in cultivated areas.

7. Barnes-Kranzburg-Buse Association

Well drained, nearly level to steep, loamy and silty soils on till plains and moraines

This association is characterized by mixed areas of nearly level topography and undulating topography and steeper slopes. Slopes generally are nearly level to gently rolling, but they are steep along drainageways and basins. The drainage pattern is mostly well defined but is poorly defined in areas where drainageways terminate in small basins. Scattered stones are on the surface in some areas.

This association makes up about 5 percent of the county. It is about 25 percent Barnes soils, 20 percent Kranzburg and similar soils, 15 percent Buse soils, and 40 percent minor soils.

Barnes soils are on summits and back slopes. Slopes range from 0 to 20 percent. Typically, the surface layer is very dark gray loam. The subsoil is brown loam in the upper part and light yellowish brown, calcareous clay loam in the lower part. The underlying material is light yellowish brown, mottled, calcareous clay loam.

Kranzburg soils are on summits and back slopes. Slopes range from 2 to 6 percent. Typically, the surface layer is dark gray silt loam. The subsoil is grayish brown and brown silt loam in the upper part; light gray, calcareous silt loam in the next part; and light gray, mottled, calcareous loam in the lower part. The underlying material is pale yellow, mottled, calcareous clay loam.

Buse soils are on shoulder slopes. Slopes range from 3 to 40 percent. Typically, the surface layer is dark gray, calcareous loam. The subsoil is pale yellow, calcareous loam. The underlying material is pale yellow, mottled, calcareous clay loam.

Of minor extent in this association are Cubden, Parnell, Southam, Svea, Tonka, and Waubay soils. The moderately well drained Cubden soils are on foot slopes. They are calcareous at or near the surface. The very poorly drained Parnell and Southam soils and the poorly drained Tonka soils are in basins. The moderately well drained Svea and Waubay soils are on foot slopes. They are dark to a depth of more than 16 inches.

About 85 percent of this association is cropland. Alfalfa, corn, small grain, and soybeans are the main crops. The hazard of erosion and the content of lime in the Buse soils are the main management concerns in cultivated areas. The major soils are suited to cultivated crops, tame pasture and hay, and range.

8. Buse-Barnes Association

Well drained, nearly level to steep, loamy soils on till plains and moraines

This association is characterized mostly by hills interrupted by narrow swales and short drainageways. The drainage pattern is well defined on the western edge of the association, where entrenched drainageways flow west off the Coteau des Prairies. Slopes generally are short and are generally rolling to hilly. Scattered stones are on the surface in some areas. The stones are more numerous on the steeper slopes at the western edge of the association.

This association makes up about 4 percent of the county. It is about 35 percent Buse soils, 30 percent Barnes soils, and 35 percent minor soils.

Buse soils are on shoulder slopes. Slopes range from 3 to 40 percent. Typically, the surface layer is dark gray, calcareous loam. The subsoil is pale yellow, calcareous loam. The underlying material is pale yellow, mottled, calcareous clay loam.

Barnes soils are on summits and back slopes. Slopes range from 0 to 25 percent. Typically, the surface layer is very dark gray loam. The subsoil is brown loam in the upper part and light yellowish brown, calcareous clay loam in the lower part. The underlying material is light yellowish brown, mottled, calcareous clay loam.

Of minor extent in this association are Aastad, Forman, Langhei, Oldham, Parnell, Renshaw, Sioux,

and Southam soils. The moderately well drained Aastad soils are on foot slopes. They are dark to a depth of more than 16 inches. Forman soils have a clay increase in the subsoil. They are on back slopes. Langhei soils do not have a dark surface layer. They are on shoulder slopes. The very poorly drained Oldham, Parnell, and Southam soils are in basins. The somewhat excessively drained Renshaw soils are on back slopes. They have gravelly material at a depth of 14 to 20 inches. The excessively drained Sioux soils are on shoulder slopes. They have gravelly material at a depth of 6 to 14 inches.

About 50 percent of this association supports native grasses and is used for grazing. Maintaining the most productive grasses and controlling erosion are the main management concerns. The less sloping areas are cultivated. Alfalfa and small grain are the main crops. The hazard of erosion and the content of lime in the Buse soils are the main management concerns in cultivated areas. The soils in this association are suited to range. Also, the less sloping areas of the Barnes soils are suited to cultivated crops and to tame pasture and hay.

9. Forman-Buse-Southam Association

Well drained and very poorly drained, level to gently rolling, loamy and silty soils on till plains and moraines

This association is characterized by rises interrupted by narrow swales and many basins. Slopes generally are short. They are mainly undulating, but in some areas they are level and in others are gently rolling to hilly. The drainage pattern is poorly defined in most areas, and drainageways terminate in large basins.

This association makes up about 5 percent of the county. It is about 30 percent Forman soils, 20 percent Buse soils, 15 percent Southam and similar soils, and 35 percent minor soils.

The well drained Forman soils are on summits and back slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark gray loam. The subsoil is dark grayish brown clay loam in the upper part and grayish brown and light brownish gray, calcareous clay loam in the lower part. The underlying material is light brownish gray, mottled, calcareous clay loam.

The well drained Buse soils are on shoulder slopes. Slopes generally range from 3 to 9 percent, but in a few places they range from 3 to 25 percent. Typically, the surface layer is dark gray, calcareous loam. The subsoil is pale yellow, calcareous loam. The underlying material is pale yellow, mottled, calcareous clay loam.

The very poorly drained Southam soils are in the deeper basins. Slopes are 0 to 1 percent. Typically, the surface layer is gray, calcareous silty clay loam. The subsurface layer is gray, mottled, calcareous silty clay loam. Below this is a transitional layer of dark gray, calcareous silty clay. The underlying material is dark gray and gray, mottled, calcareous silty clay.

Of minor extent in this association are Aastad, Fordville, Hamerly, Poinsett, Renshaw, Tonka, Vallers, and Waubay soils. The moderately well drained Aastad and Waubay soils and the well drained Fordville soils are on foot slopes. Aastad and Waubay soils are dark to a depth of more than 16 inches. Fordville soils have gravelly material at a depth of 20 to 40 inches. The somewhat poorly drained Hamerly soils are calcareous at or near the surface. They are on foot slopes. The well drained Poinsett and somewhat excessively drained Renshaw soils are on back slopes. Poinsett soils have more silt and less sand than the major soils. Renshaw soils have gravelly material at a depth of 14 to 20 inches. The poorly drained Tonka soils are in basins. The poorly drained Vallers soils are on toe slopes. They are calcareous at or near the surface.

About 65 percent of this association is cropland. Small grain, corn, soybeans, and alfalfa are the main crops. The hazard of erosion on the Forman and Buse soils, the content of lime in the Buse soils, and wetness and compaction in areas of the Southam soils are the main management concerns. The Forman and Buse soils are suited to cultivated crops, tame pasture and hay, and range. The Southam soils are suited to wetland wildlife habitat.

10. Clarno-Bonilla-Ethan Association

Well drained and moderately well drained, nearly level to moderately steep, loamy soils on till plains and moraines

This association is characterized by rises interrupted by concave areas, basins, and shallow drainageways. Slopes generally are nearly level to moderately sloping. In a few places they are strongly sloping or moderately steep. The drainage pattern is fairly well defined.

This association makes up less than 1 percent of the county. It is about 40 percent Clarno soils, 25 percent Bonilla soils, 15 percent Ethan soils, and 20 percent minor soils (fig. 5).

The well drained Clarno soils are on summits and back slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is very dark gray loam. The subsoil is dark grayish brown, brown, and pale brown loam. It is calcareous in the lower part. The underlying material is pale yellow, mottled, calcareous loam.

The moderately well drained Bonilla soils are on foot slopes. Slopes range from 0 to 4 percent. Typically, the surface soil is dark gray loam. The subsoil is dark gray and light brownish gray loam. It is calcareous in the

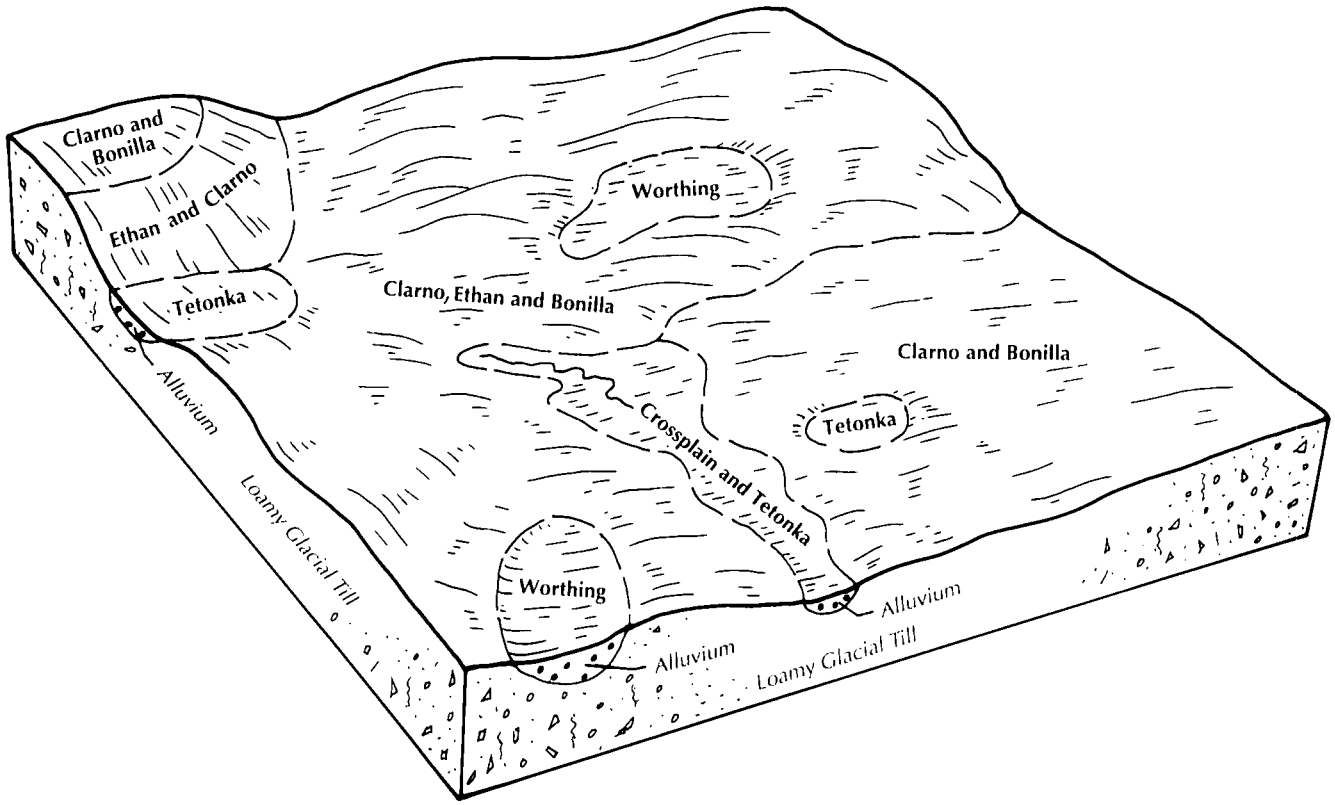

Figure 5.—Typical pattern of soils and underlying material in the Clarno-Bonilla-Ethan association.

lower part. The underlying material is light brownish gray, mottled, calcareous loam and clay loam.

The well drained Ethan soils are on shoulder slopes. Slopes range from 2 to 20 percent. Typically, the surface layer is dark grayish brown, calcareous loam. The subsoil is very pale brown, calcareous loam. The underlying material is pale yellow and light yellowish brown, mottled, calcareous loam.

Of minor extent in this association are Bon, Crossplain, Dudley, Tetonka, and Worthing soils. The moderately well drained Bon soils are on high flood plains. The somewhat poorly drained Crossplain soils are on toe slopes. The moderately well drained Stickney soils are on foot slopes. They have a sodium-affected subsoil. The poorly drained Worthing soils are in basins.

About 85 percent of this association is cropland. The main crops are alfalfa, corn, small grain, and soybeans. The hazard of erosion and the content of lime in the Ethan soils are the main management concerns. The major soils are suited to cultivated crops, to tame pasture and hay, and range. Some areas support native grasses.

Nearly Level to Gently Rolling, Silty Soils That Are Well Drained and Moderately Well Drained; on Till Plains and Moraines

These soils dominantly are nearly level to gently rolling but are level in the larger basins. They make up about 28 percent of the county. About 86 percent of the acreage is cropland. Most of the larger basins are not cultivated. Controlling erosion is the main management concern.

11. Poinsett-Waubay-Buse Association

Well drained and moderately well drained, nearly level to gently rolling, silty and loamy soils on till plains and moraines

This association is characterized by smooth slopes and scattered basins. Slopes generally are nearly level to gently rolling, but they are moderately steep along some drainageways and basins. The drainage pattern is fairly well defined. Drainage typically terminates in lakes or large basins.

This association makes up about 28 percent of the county. It is about 45 percent Poinsett soils, 20 percent

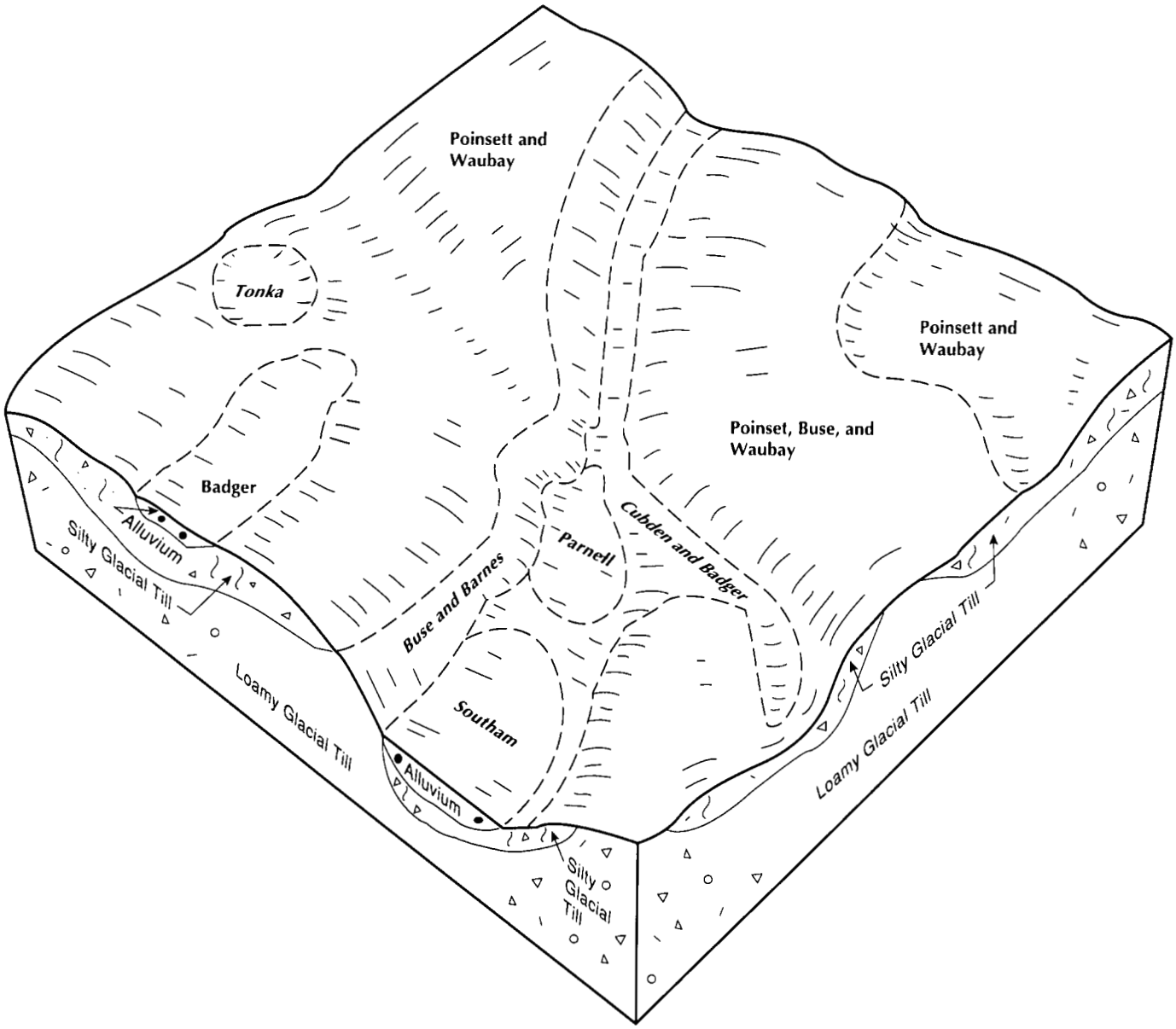

Figure 6.—Typical pattern of soils and underlying material in the Poinsett-Waubay-Buse association.

Waubay soils, 10 percent Buse soils, and 25 percent minor soils (fig. 6).

The well drained Poinsett soils are on summits and back slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark gray silty clay loam. The subsoil is dark brown, light olive brown, and light yellowish brown silt loam. It is mottled and calcareous in the lower part. The underlying material is light yellowish brown, mottled, calcareous silt loam.

The moderately well drained Waubay soils are on foot slopes. Slopes range from 0 to 6 percent. Typically, the surface soil is very dark gray silty clay loam. The subsoil is dark gray silt loam and brown silty clay loam in the upper part. It is light yellowish brown, mottled, calcareous silt loam in the lower part. The underlying material is light gray and grayish brown, mottled, calcareous silt loam.

The well drained Buse soils are on shoulder slopes. Slopes generally range from 3 to 9 percent, but in some areas they range from 3 to 20 percent. Typically, the surface layer is very dark gray, calcareous loam. The subsoil is pale yellow, calcareous loam. The underlying

material is pale yellow, mottled, calcareous clay loam.

Of minor extent in this association are Badger, Barnes, Cubden, Oldham, Parnell, Rusklyn, Southam, and Tonka soils. The somewhat poorly drained Badger soils are on toe slopes. The well drained Barnes soils are on summits and back slopes. They have more sand and less silt than the Poinsett and Waubay soils. The somewhat poorly drained Cubden soils are on foot slopes. The very poorly drained Oldham, Parnell, and Southam soils and the poorly drained Tonka soils are in basins.

About 90 percent of this association is cropland. The hazard of erosion and the content of lime in the Buse soils are the main management concerns. A few of the steeper areas are used as range. The main crops are corn, small grain, and soybeans. The soils in this association are suited to cultivated crops, tame pasture and hay, and range.

Nearly Level to Steep, Loamy Soils That Are Excessively Drained to Moderately Well Drained; on Outwash Plains and Moraines

These soils make up about 10 percent of the county. About 70 percent of the acreage is cropland. Conserving moisture and controlling erosion, especially wind erosion, are the main management concerns.

12. Egeland-Embden Association

Well drained and moderately well drained, nearly level to moderately sloping, loamy soils on outwash plains and moraines

This association is characterized by gently undulating to moderately steep slopes and intermittent basins. Slopes are generally smooth. Drainage is poorly defined. Much of the unit is between areas of gravelly outwash and very large basins.

This association makes up about 5 percent of the county. It is about 40 percent Egeland and similar soils, 25 percent Embden soils, and 35 percent minor soils.

The well drained Egeland soils are on summits and back slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is very dark gray sandy loam. The subsoil is dark grayish brown fine sandy loam, brown sandy loam, and very pale brown, calcareous fine sandy loam. The underlying material is pale brown, mottled, calcareous fine sandy loam and light yellowish brown, mottled, calcareous loamy fine sand.

The moderately well drained Embden soils are on foot slopes. Slopes range from 0 to 4 percent. Typically, the surface layer is dark gray fine sandy loam. The subsurface layer is dark gray loam. The subsoil is dark grayish brown and brown sandy loam in the upper part. It is pale brown, calcareous sandy loam and light gray, mottled, calcareous very fine sandy loam in the lower part. The underlying material is light yellowish brown, calcareous loamy sand.

Of minor extent in this association are Barnes, Cubden, Fordville, Maddock, Parnell, Poinsett, Renshaw, Rusklyn, Southam, Tonka, and Waubay soils. Barnes soils have less clay than the major soils. They are on summits and back slopes. The somewhat poorly drained Cubden and well drained Fordville soils are on foot slopes. Cubden soils are calcareous at or near the surface. Fordville soils have gravelly material at a depth of 20 to 40 inches. Maddock soils have more sand than the major soils. They are on shoulder slopes. The very poorly drained Parnell and Southam soils are in basins. Poinsett soils have more clay than the major soils. They are on summits and back slopes. Rusklyn soils are calcareous at or near the surface. They are on shoulder slopes. The moderately well drained Waubay soils have more clay than the major soils. They are on foot slopes. The somewhat excessively drained Renshaw soils have gravelly material at a depth of 14 to 20 inches. They are on back slopes. The poorly drained Tonka soils are in basins.

About 85 percent of this association is cropland. Alfalfa, corn, small grain, and soybeans are the main crops. In some areas, potatoes are grown as a specialty crop. Controlling erosion, especially wind erosion, and conserving moisture are the main management concerns in cultivated areas. The major soils are suited to cultivated crops, tame pasture and hay, and range.

13. Renshaw-Fordville Association

Somewhat excessively drained and well drained, nearly level to gently rolling, loamy soils on outwash plains and moraines

This association is characterized mainly by large flats and smooth slopes in nearly level areas. In some areas, however, slopes are undulating and gently rolling. The drainage pattern is poorly defined.

This association makes up about 3 percent of the county. It is about 40 percent Renshaw and similar soils, 25 percent Fordville soils, and 35 percent minor soils (fig. 7).

The somewhat excessively drained Renshaw soils are on summits and back slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is dark gray loam. The subsoil is brown and light yellowish brown loam. It is calcareous in the lower part. The underlying material is light gray, calcareous very gravelly loamy sand.

The well drained Fordville soils are on summits, back slopes, and foot slopes. Slopes range from 0 to 6

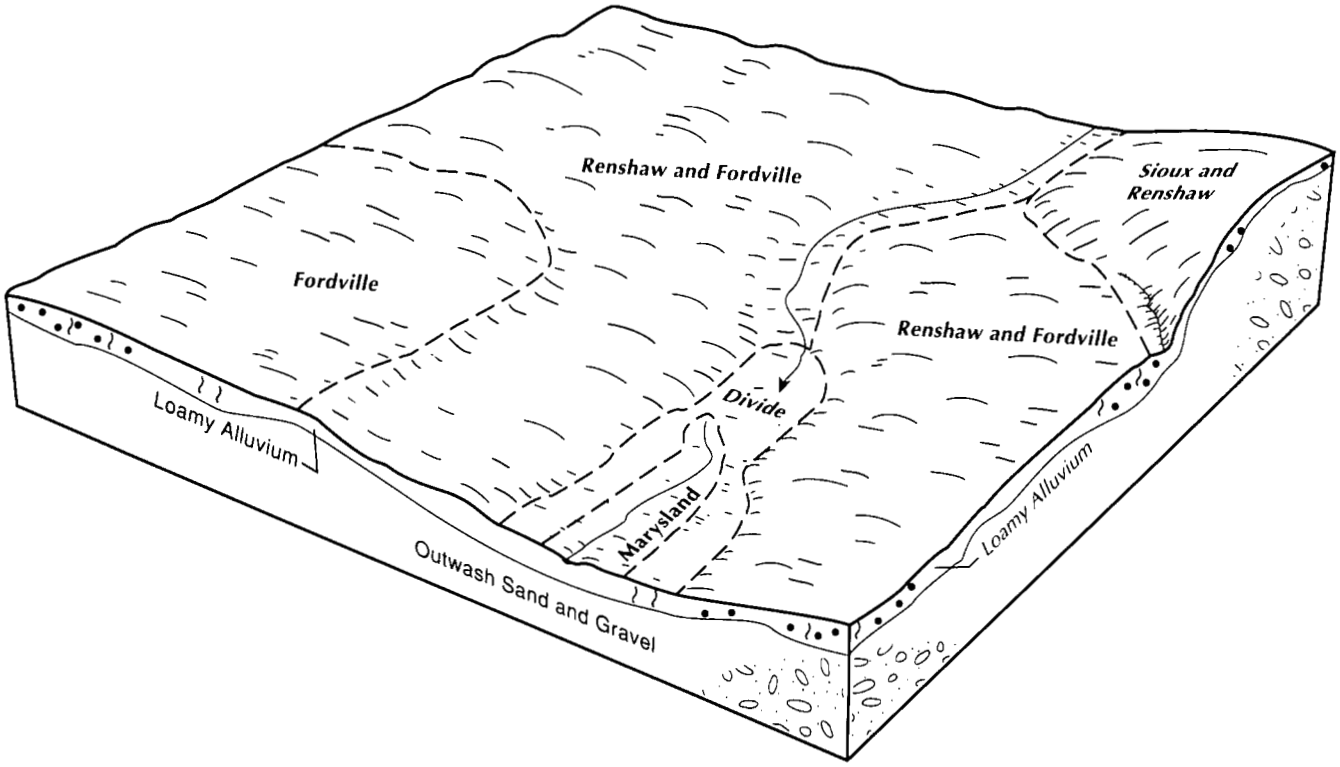

Figure 7.—Typical pattern of soils and underlying material in the Renshaw-Fordville association.

percent. Typically, the surface layer is very dark gray loam. The subsoil is dark grayish brown and brown loam. The underlying material is brown, calcareous very gravelly loamy sand and light brownish gray, calcareous gravelly sand.

Of minor extent in this association are Barnes, Buse, Divide, Egeland, Lowe, Marysland, Sioux, and Southam soils. The well drained Barnes and Buse soils do not have gravelly material within a depth of 40 inches. Barnes soils are on back slopes, and Buse soils are on shoulder slopes. The well drained Egeland soils are on summits and back slopes. They have loamy sediments throughout. The somewhat poorly drained Divide soils are on foot slopes. They are calcareous at or near the surface. The poorly drained Lowe and Marysland soils are on low flood plains. They are calcareous at or near the surface. Also, Lowe soils do not have gravel or gravelly sand above a depth of 40 inches. The excessively drained Sioux soils are on shoulder slopes. They have gravelly material at a depth of 6 to 14 inches. The very poorly drained Southam soils are in basins.

About 65 percent of this association is cropland. Alfalfa, corn, and small grain are the main crops. Conserving moisture and controlling erosion are the main management concerns in cultivated areas. The soils in this association are suited to cultivated crops, tame pasture and hay, and range, but they are somewhat droughty unless irrigated. Generally, the steeper areas of the Renshaw soils are not suited to cultivated crops. Areas that were not previously cultivated support native vegetation and are used for grazing.

14. Sioux-Renshaw Association

Excessively drained and somewhat excessively drained, nearly level to steep, loamy soils on outwash plains and moraines

This association is characterized by short slopes. Slopes generally are moderately sloping and strongly sloping, but some areas along the terminal moraine are steep. The drainage pattern is poorly defined. Most drainage terminates in large basins. Scattered stones are on the surface in some areas.

This association makes up about 3 percent of the county. It is about 30 percent Sioux soils, 30 percent Renshaw soils, and 40 percent minor soils.

The excessively drained Sioux soils are on shoulder slopes. Slopes range from 1 to 40 percent. Typically,

the surface layer is very dark gray gravelly loam. Below this is a transitional layer of dark grayish brown, calcareous gravelly sandy loam. The underlying material is light brownish gray, calcareous very gravelly loamy sand and light yellowish brown and pale brown, calcareous very gravelly sand.

The somewhat excessively drained Renshaw soils are on summits and back slopes. Slopes range from 0 to 15 percent. Typically, the surface layer is dark gray loam. The subsoil is brown and light yellowish brown loam. It is calcareous in the lower part. The underlying material is light gray, calcareous very gravelly loamy sand.

Of minor extent in this association are Barnes, Buse, Divide, Fordville, and Parnell soils. Barnes and Buse soils are not underlain by gravelly material. Barnes soils are on back slopes, and Buse soils are on shoulder slopes. The moderately well drained Divide soils are on foot slopes. They are calcareous at or near the surface. The well drained Fordville soils are on back slopes. They have gravelly material at a depth of 20 to 40 inches. The very poorly drained Parnell soils are in basins.

About 65 percent of this association supports native grass and is used for grazing or hay. Maintaining the most productive grasses and controlling erosion are the main management concerns in areas used as range. Some of the less sloping areas are cultivated. Small grain and alfalfa are the main crops. Controlling erosion and conserving moisture are the main management concerns in cultivated areas. This association is suited to range. Also, the less sloping areas of the Renshaw soils are suited to cultivated crops, tame pasture and hay, and range, but the low and very low available water capacity is a limitation. The major soils are a probable source of sand and gravel.

Level to Moderately Sloping, Loamy and Silty Soils That Are Well Drained to Poorly Drained; on Flood Plains, Till Plains, and Moraines

These soils make up about 3 percent of the county. About 62 percent of the acreage is cropland. Controlling erosion and overcoming wetness are the main management concerns.

15. Lowe-La Prairie-Playmoor Association

Moderately well drained and poorly drained, level and nearly level, loamy and silty soils on flood plains

This association is on flood plains that were formed by streams originating from the Coteau des Prairies. It is characterized by sluggish backwater areas that are flooded during wet periods and higher flood plains that formed during former periods of flooding. The drainage pattern is generally somewhat poorly defined and consists of old flood meanders that interfinger with the slightly higher till plain. The drainage pattern is well defined in the entrenched drainageways.

This association makes up about 2 percent of the county. It is about 30 percent Lowe and similar soils, 15 percent La Prairie soils, 15 percent Playmoor soils, and 40 percent minor soils.

The poorly drained Lowe soils are on low flood plains. Slopes range from 0 to 2 percent. Typically, the surface layer is very dark gray, calcareous loam. The subsoil is gray, calcareous loam. The underlying material is light gray, mottled, calcareous loam and gravelly loam.

The moderately well drained La Prairie soils are on high flood plains. Slopes range from 0 to 2 percent. Typically, the surface layer is dark gray loam. The subsurface layer is dark gray, calcareous loam. The subsoil is gray and grayish brown, calcareous loam in the upper part; light brownish gray, calcareous silt loam in the next part; and gray and grayish brown, calcareous loam in the lower part.

The poorly drained Playmoor soils are on low flood plains. Slopes are 0 to 1 percent. Typically, the surface layer is very dark gray, mottled, calcareous silty clay loam that has masses of salt. The subsoil is dark gray and very dark gray, mottled, calcareous silty clay loam that has masses of salt. The underlying material is gray, mottled, calcareous silty clay loam.

Of minor extent in this association are Aastad, Cavour, Cresbard, Divide, Embden, Ferney, Fordville, Forman, and Ludden soils. Aastad soils have a more well developed subsoil than the major soils. They are on foot slopes. The sodium-affected Cavour and Cresbard soils are on back slopes and foot slopes in areas of till plains slightly above the flood plain. The moderately well drained Divide and well drained Fordville soils are on back slopes. They have gravelly material at a depth of 20 to 40 inches. The well drained Embden soils have more sand than the major soils. They are in the slightly higher positions on the landscape, typically close to the larger drainageways. The well drained Forman soils formed in clay loam glacial till intermingled with and adjacent to the flood plain. The poorly drained Ludden soils are on low flood plains. They have more clay than the major soils.

About 60 percent of this association is cropland. Alfalfa, corn, and small grain are the main crops. Conserving moisture, maintaining fertility and tilth, and controlling erosion are the main management concerns in cultivated areas. The major soils are suited to cultivated crops and tame pasture and hay, but productivity is limited in areas of the Playmoor soils because of high salinity, a high lime content, wetness,

and compaction if the soils are tilled when wet. Productivity is also somewhat limited in areas of the Lowe soils because of a high lime content and wetness. Areas that have not been cultivated support native grasses and are used for grazing or hay.

16. Clarno-Bon Association

Well drained and moderately well drained, level to moderately sloping, loamy soils on till plains, moraines, and flood plains

This association is on narrow flood plains and the adjacent uplands. The slopes in the uplands mainly are nearly level to gently sloping, but they are moderately sloping in some areas. Many of the level and nearly level areas on the flood plains are broken by drainage channels and meander scars.

This association makes up less than 1 percent of the county. It is about 40 percent Clarno and similar soils, 25 percent Bon and similar soils, and 35 percent minor soils.

The well drained Clarno soils are on summits and back slopes. Slopes range from 0 to 9 percent. Typically, the surface layer is very dark gray loam. The subsoil is dark grayish brown, brown, and pale brown loam. It is calcareous in the lower part. The underlying material is pale yellow, mottled, calcareous loam.

The moderately well drained Bon soils are on high flood plains. Slopes range from 0 to 2 percent. Typically, the surface soil is dark gray and dark grayish brown loam. The subsoil is very dark gray and dark gray, calcareous loam in the upper part and gray, calcareous loam in the lower part. Below this is a buried layer of dark gray, calcareous loam.

Of minor extent in this association are Bonilla, Crossplain, Delmont, Ethan, and Tetonka soils. The moderately well drained Bonilla soils are on high flood plains. They are dark to a greater depth than the Clarno soils and are leached more deeply than the Bon soils. The somewhat poorly drained Crossplain soils are on toe slopes. They have more clay than the major soils. The somewhat excessively drained Delmont soils are on summits and back slopes. They have gravelly material at a depth of 14 to 20 inches. The well drained Ethan soils are on shoulder slopes. They are calcareous at or near the surface. The poorly drained Tetonka soils are in small basins.

About 75 percent of this association is cropland. The main crops are alfalfa, corn, small grain, and soybeans. The remaining acreage is mainly used as range. The hazard of erosion and the content of lime in the Bon soils are the main management concerns. The major soils are suited to cultivated crops, tame pasture and hay, and range.

Detailed Soil Map Units

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

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

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

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the underlying material, 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 underlying material. 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, La Prairie loam is a phase of the La Prairie series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Poinsett-Buse-Waubay complex, 1 to 6 percent slopes, is an example.

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

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

Aa—Aastad loam

Composition

Aastad and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Foot slopes
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 5 to 100 acres

Typical Profile

Surface soil:
0 to 18 inches—dark gray loam

Subsoil:
18 to 23 inches—dark grayish brown clay loam
23 to 32 inches—light olive brown clay loam
32 to 44 inches—light yellowish brown, calcareous clay loam

Underlying layer:
44 to 60 inches—light olive brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches

Depth to the water table: 2.5 to 4.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: Runoff water flows over the Aastad soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The well drained Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on back slopes
• The well drained Forman soils, which are dark to a depth of less than 16 inches; on back slopes
• The somewhat poorly drained Hamerly soils, which are calcareous at or near the surface; on foot slopes
• The very poorly drained Parnell soils in basins

Similar inclusions:
• Soils that are dark to a depth of more than 24 inches
• Soils that have an increase of clay in the subsoil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat
Suitability for cropland: Well suited
Limitations: Slight
Management measures:
• Managing crop residue conserves moisture and helps to maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: I-3
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: K

At—Aastad-Tonka complex

Composition

Aastad and similar soils: 55 to 70 percent
Tonka and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Aastad—foot slopes; Tonka—basins
Slope range: Aastad—0 to 2 percent; Tonka—0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 40 acres

Typical Profile

Aastad

Surface soil:
0 to 18 inches—dark gray loam

Subsoil:
18 to 23 inches—dark grayish brown clay loam
23 to 32 inches—light olive brown clay loam
32 to 44 inches—light yellowish brown, calcareous clay loam

Underlying layer:
44 to 60 inches—light olive brown, mottled, calcareous clay loam

Tonka

Surface layer:
0 to 14 inches—dark gray silty clay loam

Subsurface layer:
14 to 24 inches—gray, mottled silt loam

Subsoil:
24 to 46 inches—dark gray, mottled silty clay loam
46 to 53 inches—grayish brown, mottled silty clay loam

Underlying layer:
53 to 60 inches—light brownish gray, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Aastad—moderately well drained; Tonka—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: Aastad—at a depth of 2.5 to 4.0 feet; Tonka—0.5 foot above to 1.0 foot below the surface
Flooding: None
Ponding: Aastad—none; Tonka—frequent for long periods
Permeability: Aastad—moderately slow; Tonka—slow
Available water capacity: High
Organic matter content: High
Surface runoff: Aastad—slow; Tonka—negligible
Other properties: Runoff water flows over the Aastad soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The well drained Forman soils, which are dark to a depth of less than 16 inches; on back slopes
• The very poorly drained Parnell soils in basins
• The poorly drained Vallers soils, which are calcareous at or near the surface; on toe slopes

Similar inclusions:
• Soils that have more silt and less sand throughout than the Aastad soil
• Soils that have more sand and less clay throughout than the Aastad soil
• Soils that have a gray surface layer; in areas where the original surface and subsurface layers or the subsoil has been mixed by cultivation

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Aastad—alfalfa, barley, corn, oats, soybeans, and spring wheat; Tonka—barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Aastad—only slight limitations; Tonka—wetness
Management measures:
• In most years the Tonka soil is better suited to late planted crops than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to maintain tilth and improve the rate of water infiltration.
• Delaying tillage when the Tonka soil is wet helps to prevent surface compaction.

Interpretive Groups

Land capability classification: Aastad—I-3; Tonka—IVw-2
Range site: Aastad—Loamy Overflow; Tonka—Wet Meadow
Windbreak suitability group: Aastad—1; Tonka—10
Pasture suitability group: Aastad—K; Tonka—B2

Ba—Badger-Tonka silty clay loams

Composition

Badger and similar soils: 55 to 70 percent
Tonka and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Badger—toe slopes; Tonka—basins
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 40 acres

Typical Profile

Badger

Surface soil:
0 to 15 inches—dark gray silty clay loam

Subsoil:
15 to 30 inches—dark gray and gray silty clay loam
30 to 38 inches—light brownish gray, mottled silty clay loam

Underlying layer:
38 to 60 inches—light gray, mottled, calcareous silt loam

Tonka

Surface layer:
0 to 14 inches—dark gray silty clay loam

Subsurface layer:
14 to 24 inches—gray, mottled silt loam

Subsoil:
24 to 46 inches—dark gray, mottled silty clay loam
46 to 53 inches—grayish brown, mottled silty clay loam

Underlying layer:
53 to 60 inches—light brownish gray, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Badger—somewhat poorly drained; Tonka—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Badger—40 to more than 60 inches over glacial till; Tonka—greater than 60 inches
Seasonal high water table: Badger—at the surface to 3 feet below the surface; Tonka—0.5 foot above to 1.0 foot below the surface
Flooding: Badger—frequent for brief periods; Tonka—none
Ponding: Badger—none; Tonka—frequent for long periods
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Badger—very slow; Tonka—negligible

Inclusions

Contrasting inclusions:
• The moderately well drained Waubay soils on foot slopes
• Cubden soils, which are calcareous at or near the surface; on foot slopes along the edges of the unit
• The very poorly drained Parnell soils in the deeper basins

Similar inclusions:
• Soils that are calcareous closer to the surface than the Badger soil
• Soils that have a gray surface layer; in areas where material from the original surface and subsurface layers has been mixed by cultivation

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Wetness
Management measures:
• In wet years these soils are better suited to late planted crops than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to maintain tilth and improve the rate of water infiltration.
• Deferring tillage when these soils are wet helps to prevent surface compaction.

Interpretive Groups

Land capability classification: Badger—IIw-1; Tonka—IVw-2
Range site: Badger—Loamy Overflow; Tonka—Wet Meadow
Windbreak suitability group: Badger—2; Tonka—10
Pasture suitability group: Badger—A; Tonka—B2

BbB—Barnes-Buse loams, 2 to 6 percent slopes

Composition

Barnes and similar soils: 50 to 60 percent
Buse and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Barnes—summits and back slopes; Buse—shoulder slopes
Slope range: Barnes—2 to 6 percent; Buse—3 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Barnes

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 15 inches—brown loam
15 to 34 inches—light yellowish brown, calcareous clay loam
Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam
Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam
Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Barnes—high; Buse—moderately low
Surface runoff: Medium
Other properties: The Buse soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on shoulder slopes
• The moderately well drained Svea soils on foot slopes
Similar inclusions:
• Soils that have less sand between the depths of 10 and 40 inches than the Barnes soil
• Soils that have more clay in the subsoil than the Barnes soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Barnes—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular to be farmed on the contour.

• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Barnes—IIe-2; Buse—IIIe-6
Range site: Barnes—Silty; Buse—Thin Upland
Windbreak suitability group: Barnes—3; Buse—8
Pasture suitability group: Barnes—F; Buse—G

BbC—Barnes-Buse loams, 6 to 9 percent slopes

Composition

Barnes and similar soils: 50 to 60 percent
Buse and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Barnes—back slopes; Buse—shoulder slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Barnes

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 15 inches—brown loam
15 to 34 inches—light yellowish brown, calcareous clay loam
Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam
Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam
Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Barnes—high; Buse—moderately low
Surface runoff: Medium
Other properties: The Buse soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The well drained Kranzburg soils, which have more silt and less sand in the surface layer and the upper part of the subsoil than the Barnes soil; on back slopes
• The very poorly drained Parnell soils in basins
• The moderately well drained Svea soils, which are dark to a depth of more than 16 inches; on foot slopes
Similar inclusions:
• Soils that have more clay in the subsoil than the Barnes soil
• Soils that have more silt throughout than the Buse soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Barnes—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming, terraces, and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular for terraces or for contour farming.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Barnes—IIIe-1; Buse—IVe-2
Range site: Barnes—Silty; Buse—Thin Upland
Windbreak suitability group: Barnes—3; Buse—8
Pasture suitability group: Barnes—F; Buse—G

BcB—Barnes-Buse-Svea loams, 1 to 6 percent slopes

Composition

Barnes and similar soils: 30 to 45 percent
Buse and similar soils: 25 to 35 percent
Svea and similar soils: 15 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Barnes—summits and back slopes; Buse—shoulder slopes; Svea—foot slopes
Slope range: Barnes—2 to 6 percent; Buse—3 to 6 percent; Svea—1 to 2 percent
Shape of areas: Irregular
Size of areas: 40 to 500 acres

Typical Profile

Barnes

Surface layer:
0 to 7 inches—very dark gray loam

Subsoil:
7 to 15 inches—brown loam
15 to 34 inches—light yellowish brown, calcareous clay loam

Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Svea

Surface layer:
0 to 15 inches—very dark gray loam

Subsoil:
15 to 20 inches—dark gray loam
20 to 26 inches—grayish brown clay loam
26 to 31 inches—light brownish gray, calcareous loam
31 to 48 inches—light brownish gray, mottled, calcareous clay loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Barnes—well drained; Buse—well drained; Svea—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Barnes—greater than 6 feet; Buse—greater than 6 feet; Svea—3 to 5 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Barnes—high; Buse—moderately low; Svea—high
Surface runoff: Barnes—medium; Buse—medium; Svea—slow
Other properties: The Buse soil has a high content of lime. Runoff water flows over the Svea soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes
• The very poorly drained Parnell soils and the poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more clay in the subsoil than the Barnes and Svea soils

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Barnes—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Svea—only slight limitations
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture (fig. 8).
• Contour farming and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular to be farmed on the contour.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Barnes soil—IIe-2;

Figure 8.—Harvesting wheat in an area of Barnes-Buse-Svea loams, 1 to 6 percent slopes. Leaving crop residue on the surface helps to control erosion.

Buse soil—IIIe-6; Svea soil—I-3
Range site: Barnes—Silty; Buse—Thin Upland; Svea—Loamy Overflow
Windbreak suitability group: Barnes—3; Buse—8; Svea—1
Pasture suitability group: Barnes—F; Buse—G; Svea—K

BcC—Barnes-Buse-Svea loams, 2 to 9 percent slopes

Composition

Barnes and similar soils: 30 to 50 percent
Buse and similar soils: 25 to 45 percent
Svea and similar soils: 10 to 20 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Barnes—summits and back slopes; Buse—shoulder slopes; Svea—foot slopes
Slope range: Barnes—6 to 9 percent; Buse—6 to 9 percent; Svea—2 to 6 percent
Shape of areas: Irregular
Size of areas: 20 to 300 acres

Typical Profile

Barnes

Surface layer:
0 to 7 inches—very dark gray loam

Subsoil:
7 to 15 inches—brown loam

15 to 34 inches—light yellowish brown, calcareous clay loam

Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Svea

Surface soil:
0 to 15 inches—very dark gray loam

Subsoil:
15 to 20 inches—dark gray loam
20 to 26 inches—grayish brown clay loam
26 to 31 inches—light brownish gray, calcareous loam
31 to 48 inches—light brownish gray, mottled, calcareous clay loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Barnes—well drained; Buse—well drained; Svea—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Barnes—greater than 6 feet; Buse—greater than 6 feet; Svea—3 to 5 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Barnes—high; Buse—moderately low; Svea—high
Surface runoff: Medium
Other properties: The Buse soil has a high content of lime. Runoff water flows over the Svea soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on shoulder slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more clay in the subsoil than the Barnes and Svea soils
• Soils that have more silt and less sand throughout
• Soils that have more sand and less clay throughout than the Barnes soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Barnes—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Svea—only slight limitations
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming, terraces, and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular for terraces or for contour farming.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Barnes—IIIe-1; Buse—IVe-2; Svea—IIe-1
Range site: Barnes—Silty; Buse—Thin Upland; Svea—Silty
Windbreak suitability group: Barnes—3; Buse—8; Svea—1
Pasture suitability group: Barnes—F; Buse—G; Svea—K

BdA—Barnes-Svea loams, 0 to 2 percent slopes

Composition

Barnes and similar soils: 45 to 55 percent
Svea and similar soils: 35 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Barnes—summits and back slopes; Svea—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

Barnes

Surface layer:
0 to 7 inches—very dark gray loam

Subsoil:
7 to 15 inches—brown loam
15 to 34 inches—light yellowish brown, calcareous clay loam

Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Svea

Surface soil:
0 to 15 inches—very dark gray loam

Subsoil:
15 to 20 inches—dark gray loam
20 to 26 inches—grayish brown clay loam
26 to 31 inches—light brownish gray, calcareous loam
31 to 48 inches—light brownish gray, mottled, calcareous clay loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Barnes—well drained; Svea—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Barnes—greater than 6 feet; Svea—3 to 5 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: Runoff water flows over the Svea soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Badger soils on toe slopes
• The very poorly drained Parnell soils in basins
• The poorly drained Vallers soils on toe slopes and around the edges of basins

Similar inclusions:
• Soils that have more clay in the subsoil than the Barnes soil
• Soils that have more silt in the surface layer and subsoil than the Barnes soil
• Soils that have more clay in the subsoil than the Svea soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Limitations: Slight
Management measures:
• Managing crop residue conserves moisture and helps to maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Barnes—I-2; Svea—I-3
Range site: Barnes—Silty; Svea—Loamy Overflow
Windbreak suitability group: Barnes—3; Svea—1
Pasture suitability group: Barnes—F; Svea—K

BdB—Barnes-Svea loams, 1 to 6 percent slopes

Composition

Barnes and similar soils: 60 to 70 percent
Svea and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Barnes—summits and back slopes; Svea—foot slopes
Slope range: Barnes—2 to 6 percent; Svea—1 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Barnes

Surface layer:
0 to 7 inches—very dark gray loam

Subsoil:
7 to 15 inches—brown loam
15 to 34 inches—light yellowish brown, calcareous clay loam

Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Svea

Surface soil:
0 to 15 inches—very dark gray loam

Subsoil:
15 to 20 inches—dark gray loam
20 to 26 inches—grayish brown clay loam
26 to 31 inches—light brownish gray, calcareous loam
31 to 48 inches—light brownish gray, mottled, calcareous clay loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Barnes—well drained; Svea—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Barnes—greater than 6 feet; Svea—3 to 5 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Barnes—medium; Svea—slow
Other properties: Runoff water flows over the Svea soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Badger soils on toe slopes
• Buse soils, which have carbonates at or near the surface; on shoulder slopes
• The very poorly drained Parnell soils in basins
• The poorly drained Vallers soils on toe slopes and around the edges of basins

Similar inclusions:
• Soils that have more clay in the subsoil than the Barnes soil
• Soils that have more silt in the surface layer and subsoil than the Barnes soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Barnes—water erosion; Svea—only slight limitations
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular to be farmed on the contour.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Barnes—IIe-2; Svea—I-3
Range site: Barnes—Silty; Svea—Loamy Overflow
Windbreak suitability group: Barnes—3; Svea—1
Pasture suitability group: Barnes—F; Svea—K

BeA—Beadle loam, 0 to 2 percent slopes

Composition

Beadle and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Till plains
Position on the landform: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

Surface layer:
0 to 8 inches—very dark gray loam

Subsoil:
8 to 15 inches—dark gray clay loam
15 to 33 inches—grayish brown and light yellowish brown, calcareous clay loam

Underlying layer:
33 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The moderately well drained Stickney soils, which have a subsoil that is only slightly affected by sodium; on the lower back slopes

• The somewhat poorly drained Crossplain soils on foot slopes
• The moderately well drained Dudley soils, which have a sodium-affected subsoil; on foot slopes
• The poorly drained Tetonka soils in basins

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Slow rate of water infiltration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and help to maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIs-1
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: E

BeB—Beadle loam, 2 to 6 percent slopes

Composition

Beadle and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Till plains
Position on the landform: Summits and back slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 8 inches—very dark gray loam
Subsoil:
8 to 15 inches—dark gray clay loam
15 to 33 inches—grayish brown and light yellowish brown, calcareous clay loam
Underlying layer:
33 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Medium

Inclusions

Contrasting inclusions:
• The moderately well drained Dudley soils, which have a sodium-affected subsoil; on foot slopes
• The moderately well drained Stickney soils, which have a subsoil that is only slightly affected by sodium; on the lower back slopes
• The poorly drained Tetonka soils in basins
Similar inclusions:
• Soils that have less clay in the subsoil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Water erosion, slow rate of water infiltration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture, help to control water erosion, and help to maintain tilth and the content of organic matter.
• Contour farming and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular to be farmed on the contour.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe-3
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: E

BeC—Beadle loam, 6 to 9 percent slopes

Composition

Beadle and similar soils: 75 to 80 percent
Contrasting inclusions: 20 to 25 percent

Setting

Landform: Moraines
Position on the landform: Summits and back slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 40 acres

Typical Profile

Surface layer:
0 to 8 inches—very dark gray loam

Subsoil:
8 to 15 inches—dark gray clay loam
15 to 33 inches—grayish brown and light yellowish brown, calcareous clay loam

Underlying layer:
33 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Rapid

Inclusions

Contrasting inclusions:
• The moderately well drained Dudley soils, which have a sodium-affected subsoil; on foot slopes
• The moderately well drained Stickney soils, which have a subsoil that is only slightly affected by sodium; on the lower back slopes
• The well drained Ethan and Betts soils, which are calcareous at or near the surface; on shoulder slopes

Similar inclusions:
• Soils that have less clay in the subsoil

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, barley, corn, spring wheat, and sunflowers
Suitability for cropland: Poorly suited
Management concerns: Water erosion, slow rate of water infiltration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture, help to control water erosion, and help to maintain tilth and the content of organic matter.
• Contour farming, terraces, and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular for terraces or for contour farming.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IVe-7
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: E

BfA—Beadle-Dudley complex, 0 to 2 percent slopes

Composition

Beadle and similar soils: 50 to 65 percent
Dudley and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Beadle—summits and back slopes; Dudley—foot slopes
Slope range: Beadle—0 to 2 percent; Dudley—0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Beadle

Surface layer:
0 to 8 inches—very dark gray loam

Subsoil:
8 to 15 inches—dark gray clay loam
15 to 33 inches—grayish brown and light yellowish brown, calcareous clay loam

Underlying layer:
33 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Dudley

Surface layer:
0 to 8 inches—dark gray silt loam

Subsurface layer:
8 to 11 inches—gray silt loam

Subsoil:
11 to 28 inches—dark gray clay

28 to 34 inches—very dark gray clay that has nests of salt
34 to 42 inches—light brownish gray, calcareous silty clay that has nests of gypsum and other salts
42 to 50 inches—light yellowish brown, mottled, calcareous clay loam

Underlying layer:
50 to 60 inches—olive gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Beadle—well drained; Dudley—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Beadle—greater than 6 feet; Dudley—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Beadle—slow; Dudley—very slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Other properties: A sodium-affected subsoil restricts root penetration and the rate of water infiltration in the Dudley soil.

Inclusions

Contrasting inclusions:
• The moderately well drained Stickney soils, which have a subsoil that is only slightly affected by sodium; on the lower back slopes
• The poorly drained Hoven soils in basins

Similar inclusions:
• Soils that have less clay in the subsoil than the Beadle soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Beadle—slow rate of water infiltration; Dudley—a slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and help to maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry can increase the rate of water infiltration.

Interpretive Groups

Land capability classification: Beadle—IIs-1; Dudley—IVs-2
Range site: Beadle—Clayey; Dudley—Claypan
Windbreak suitability group: Beadle—4; Dudley—9
Pasture suitability group: Beadle—E; Dudley—C

BkD—Betts-Ethan loams, 9 to 20 percent slopes

Composition

Betts and similar soils: 35 to 45 percent
Ethan and similar soils: 35 to 50 percent
Contrasting inclusions: 10 to 25 percent

Setting

Landform: Moraines
Position on the landform: Betts—shoulder slopes; Ethan—summits and back slopes
Slope range: 9 to 20 percent
Shape of areas: Irregular
Size of areas: 20 to 100 acres

Typical Profile

Betts

Surface layer:
0 to 5 inches—dark gray, calcareous loam

Subsoil:
5 to 11 inches—grayish brown, calcareous loam
11 to 26 inches—light olive brown, calcareous clay loam

Underlying layer:
26 to 34 inches—light yellowish brown, mottled, calcareous clay loam
34 to 60 inches—light olive brown, mottled, calcareous clay loam

Ethan

Surface layer:
0 to 9 inches—dark grayish brown, calcareous loam

Subsoil:
9 to 30 inches—very pale brown, calcareous loam

Underlying layer:
30 to 45 inches—pale yellow, mottled, calcareous loam
45 to 60 inches—light yellowish brown, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None

Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Betts—low; Ethan—moderately low
Surface runoff: Rapid
Other properties: Both soils have a high content of lime. Scattered stones are on the surface of both soils in some areas.

Inclusions

Contrasting inclusions:
• The moderately well drained Bonilla soils on foot slopes
• The well drained Clarno soils, which are calcareous below a depth of 10 inches; on the lower back slopes
• The somewhat poorly drained Crossplain soils on toe slopes

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.

Interpretive Groups

Land capability classification: Betts—VIe-3; Ethan—VIe-3
Range site: Betts—Thin Upland; Ethan—Thin Upland
Windbreak suitability group: Betts—8; Ethan—8
Pasture suitability group: Betts—G; Ethan—G

BmA—Blendon fine sandy loam, 0 to 2 percent slopes

Composition

Blendon and similar soils: 75 to 90 percent
Contrasting inclusions: 10 to 25 percent

Setting

Landform: Outwash plains
Position on the landform: Foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 20 acres

Typical Profile

Surface layer:
0 to 8 inches—very dark grayish brown fine sandy loam
Subsoil:
8 to 22 inches—dark grayish brown sandy loam
Underlying layer:
22 to 42 inches—brown sandy loam
42 to 60 inches—yellowish brown, calcareous loamy fine sand

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over glacial till
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately rapid
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Delmont soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes
• Enet soils, which have gravelly material at a depth of 20 to 40 inches; in positions on the landscape similar to those of the Blendon soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Wind erosion, moderate available water capacity
Management measures:
• This soil is better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Wind stripcropping and field windbreaks help to control wind erosion.

Interpretive Groups

Land capability classification: IIIe-7
Range site: Sandy
Windbreak suitability group: 5
Pasture suitability group: H

Bn—Bon loam

Composition

Bon and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Flood plains
Position on the landform: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

Surface soil:
0 to 18 inches—dark gray and dark grayish brown loam that is calcareous in the lower part

Subsoil:
18 to 24 inches—very dark gray, calcareous loam
24 to 28 inches—dark gray, calcareous loam
28 to 48 inches—gray, calcareous loam

Underlying layer:
48 to 60 inches—dark gray, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 3 to 5 feet
Flooding: Rare
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The poorly drained Salmo soils, which have salts at or near the surface; on low flood plains
• The somewhat excessively drained Delmont soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes
• The somewhat poorly drained Lamo soils on low flood plains

Similar inclusions:
• Soils that have more carbonates in the subsoil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Conserving moisture
Management measures:
• Managing crop residue conserves moisture and helps to maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: IIc-1
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: K

Bo—Bon loam, channeled

Composition

Bon and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 20 to 100 acres

Typical Profile

Surface soil:
0 to 18 inches—dark gray and dark grayish brown loam that is calcareous in the lower part

Subsoil:
18 to 24 inches—very dark gray, calcareous loam
24 to 28 inches—dark gray, calcareous loam
28 to 48 inches—gray, calcareous loam

Underlying layer:
48 to 60 inches—dark gray, calcareous loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 3 to 5 feet
Flooding: Frequent for brief periods
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: Areas of this soil typically are dissected by a meandering channel.

Inclusions

Contrasting inclusions:
• The poorly drained Salmo soils, which have salts at or near the surface; on low flood plains
• The somewhat excessively drained Delmont soils,

which have gravelly material at a depth of 14 to 20 inches; on back slopes
• The somewhat poorly drained Lamo soils on low flood plains

Similar inclusions:
• Soils that have more carbonates in the subsoil

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited
Management concerns: Wetness and the meandering channels, which limit cultivation

Rangeland

Management measures:
• Proper grazing management maintains plant vigor and helps to control streambank erosion.

Interpretive Groups

Land capability classification: Vlw-1
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: NS

BrD—Buse-Barnes loams, 9 to 20 percent slopes

Composition

Buse and similar soils: 45 to 60 percent
Barnes and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Buse—shoulder slopes; Barnes—back slopes
Slope range: Buse—9 to 20 percent; Barnes—9 to 15 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Barnes

Surface layer:
0 to 7 inches—very dark gray loam

Subsoil:
7 to 15 inches—brown loam
15 to 34 inches—light yellowish brown, calcareous clay loam

Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Buse—moderately low; Barnes—high
Surface runoff: Rapid
Other properties: The Buse soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The excessively drained Sioux soils, which have gravelly material within a depth of 14 inches; on summits and shoulder slopes
• The poorly drained Holmquist soils along narrow channeled drainageways on low flood plains

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Main crops: Buse—generally unsuited to crops; Barnes—alfalfa, barley, oats, and spring wheat
Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Barnes—water erosion
Management measures:
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.
• Seeding cultivated areas to adapted grasses helps to control erosion.

Interpretive Groups

Land capability classification: Buse—VIe-3; Barnes—IVe-1
Range site: Buse—Thin Upland; Barnes—Silty
Windbreak suitability group: Buse—8; Barnes—3
Pasture suitability group: Buse—G; Barnes—F

BsE—Buse-Barnes loams, 9 to 40 percent slopes, very stony

Composition

Buse and similar soils: 40 to 55 percent
Barnes and similar soils: 35 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Buse—shoulder slopes; Barnes—back slopes
Slope range: Buse—9 to 40 percent; Barnes—9 to 25 percent
Shape of areas: Irregular
Size of areas: 40 to 200 acres

Typical Profile

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam
Subsoil:
7 to 20 inches—pale yellow, calcareous loam
Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Barnes

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 15 inches—brown loam
15 to 34 inches—light yellowish brown, calcareous clay loam
Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Buse—moderately low; Barnes—high
Surface runoff: Buse—very rapid; Barnes—rapid
Other properties: The Buse soil has a high content of lime. Scattered stones and boulders are on the surface.

Inclusions

Contrasting inclusions:
• The very poorly drained Parnell soils in basins
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes
• The excessively drained Sioux soils, which have gravelly material within a depth of 14 inches; on shoulder slopes
• The moderately well drained Svea soils, which are dark to a depth of more than 16 inches; on foot slopes
• The poorly drained Vallers soils on toe slopes and around the edges of basins

Similar inclusions:
• Soils that have more silt in the surface layer and subsoil than the Buse soil
• Soils that have more clay in the subsoil than the Barnes soil

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Generally unsuited

Rangeland

Management concerns: Buse—wind erosion, water erosion, stoniness; Barnes—water erosion, stoniness (granitic rocks 1 to 3 feet in diameter cover 0.1 to 3.0 percent of the surface)
Management measures:
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.

Interpretive Groups

Land capability classification: Buse—VIIs-1; Barnes—VIIs-1
Range site: Buse—Thin Upland; Barnes—Silty
Windbreak suitability group: Buse—10; Barnes—10
Pasture suitability group: Buse—NS; Barnes—NS

BuE—Buse-La Prairie, channeled-Barnes loams, 0 to 40 percent slopes

Composition

Buse and similar soils: 30 to 50 percent

La Prairie and similar soils: 25 to 40 percent
Barnes and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines and flood plains
Position on the landform: Buse—shoulder slopes; La Prairie—high flood plains; Barnes—back slopes
Slope range: Buse—9 to 40 percent; La Prairie—0 to 2 percent; Barnes—9 to 25 percent
Shape of areas: Irregular
Size of areas: 100 to 400 acres

Typical Profile

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

La Prairie

Surface layer:
0 to 8 inches—dark gray loam

Subsurface layer:
8 to 18 inches—dark gray, calcareous loam

Subsoil:
18 to 30 inches—gray and grayish brown, calcareous loam
30 to 50 inches—light brownish gray, calcareous silt loam
50 to 60 inches—gray and grayish brown, calcareous silt loam

Barnes

Surface layer:
0 to 7 inches—very dark gray loam

Subsoil:
7 to 15 inches—brown loam
15 to 34 inches—light yellowish brown, calcareous clay loam

Underlying layer:
34 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Buse—well drained; La Prairie—moderately well drained; Barnes—well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Buse—greater than 60 inches; La Prairie—40 to more than 60 inches over clayey or sandy material; Barnes—greater than 60 inches
Depth to the water table: Buse—greater than 6 feet; La Prairie—3.5 to 5.0 feet; Barnes—greater than 6 feet
Flooding: Buse—none; La Prairie—occasional for brief periods; Barnes—none
Ponding: None
Permeability: Buse—moderately slow; La Prairie—moderate; Barnes—moderately slow
Available water capacity: High
Organic matter content: Buse—moderately low; La Prairie—high; Barnes—high
Surface runoff: Buse—very rapid; La Prairie—slow; Barnes—rapid
Other properties: The Buse soil has a high content of lime. Some areas of the Buse soil have scattered stones and boulders on the surface. The La Prairie soil typically is dissected by a meandering channel (fig. 9).

Inclusions

Contrasting inclusions:
• The moderately well drained Aastad soils on foot slopes
• The poorly drained Holmquist soils, which are stratified; on low flood plains
• The well drained Kranzburg soils, which have less sand and more silt in the surface layer than the major soils; on back slopes
• The excessively drained Sioux soils, which have gravelly material within a depth of 14 inches; on shoulder slopes

Similar inclusions:
• Soils that have a thinner surface layer than the Buse soil
• Soils that have more silt and less sand than the La Prairie soil
• Soils that have more clay in the subsoil than the Barnes soil

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Generally unsuited

Rangeland

Management concerns: Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; La Prairie—meandering channels; Barnes—water erosion

Management measures:
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.

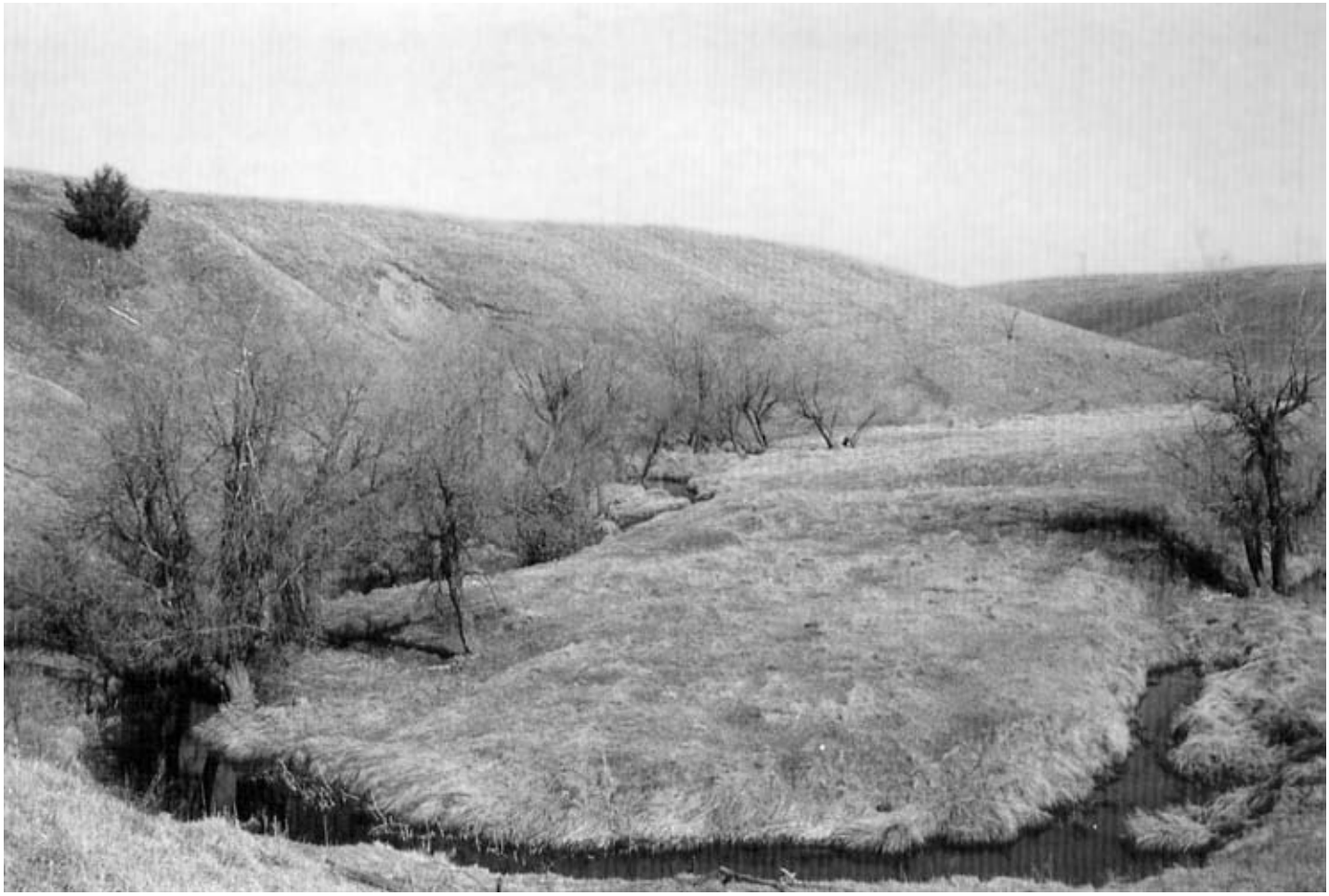

Figure 9.—A stream meander in an area of Buse-La Prairie, channeled-Barnes loams, 0 to 40 percent slopes. Areas of this unit are generally not accessible for farming and thus are more suitable for grazing or as wildlife habitat.

Interpretive Groups

Land capability classification: Buse—VIIe-1; La Prairie—VIw-1; Barnes—VIe-1
Range site: Buse—Thin Upland; La Prairie—Loamy Overflow; Barnes—Silty
Windbreak suitability group: Buse—10; La Prairie—1; Barnes—10
Pasture suitability group: Buse—NS; La Prairie—NS; Barnes—NS

ByE—Buse-Langhei complex, 15 to 40 percent slopes

Composition

Buse and similar soils: 50 to 65 percent
Langhei and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Buse—shoulder slopes and back slopes; Langhei—shoulder slopes
Slope range: Buse—15 to 40 percent; Langhei—25 to 40 percent
Shape of areas: Irregular
Size of areas: 20 to 100 acres

Typical Profile

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam
Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Langhei

Surface layer:
0 to 3 inches—dark gray clay loam
Transitional layer:
3 to 7 inches—light brownish gray clay loam
Underlying layer:
7 to 54 inches—light yellowish brown, mottled, calcareous clay loam
54 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Buse—moderately low; Langhei—low
Surface runoff: Very rapid
Other properties: Both soils have a high content of lime. Scattered stones are on the surface of both soils in some areas.

Inclusions

Contrasting inclusions:
• The moderately well drained Aastad soils on foot slopes
• The well drained Barnes and Forman soils, which are dark to a depth of more than 7 inches; on summits and back slopes
• Maddock soils, which have more sand throughout than the major soils; in positions on the landscape similar to those of the Buse soil
• The excessively drained Sioux soils, which have gravelly material at a depth of 6 to 14 inches; on shoulder slopes

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Generally unsuited

Rangeland

Management concerns: Wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.

Interpretive Groups

Land capability classification: Buse—VIIe-1; Langhei—VIIe-1
Range site: Buse—Thin Upland; Langhei—Thin Upland
Windbreak suitability group: Buse—10; Langhei—10
Pasture suitability group: Buse—NS; Langhei—NS

BzE—Buse-Sioux complex, 9 to 40 percent slopes

Composition

Buse and similar soils: 50 to 60 percent
Sioux and similar soils: 20 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Shoulder slopes and back slopes
Slope range: 9 to 40 percent
Shape of areas: Irregular
Size of areas: 20 to 100 acres

Typical Profile

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam
Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam
Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Sioux

Surface layer:
0 to 7 inches—very dark gray, calcareous gravelly loam
Transitional layer:
7 to 11 inches—dark grayish brown, calcareous gravelly loam
Underlying layer:
11 to 26 inches—light brownish gray, calcareous very gravelly loamy sand
26 to 60 inches—light yellowish brown and pale brown, calcareous very gravelly sand

Soil Properties and Qualities

Drainage class: Buse—well drained; Sioux—excessively drained

Depth to bedrock: Very deep
Depth to contrasting layer: Buse—greater than 60 inches; Sioux—6 to 14 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Buse—moderately slow; Sioux—very rapid
Available water capacity: Buse—high; Sioux—very low
Organic matter content: Moderately low
Surface runoff: Buse—very rapid; Sioux—medium
Other properties: The Buse soil has a high content of lime. Scattered stones are on the surface in some areas.

Inclusions

Contrasting inclusions:
• The moderately well drained Aastad soils on foot slopes
• The well drained Barnes soils, which are dark to a depth of more than 7 inches; on back slopes
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes

Similar inclusions:
• Soils that have a thinner surface layer than the Buse soil
• Soils that have clay loam underlying material below a depth of 40 inches

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Sioux—water erosion, very low available water capacity
Management measures:
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.

Interpretive Groups

Land capability classification: Buse—VIIe-1; Sioux—VIIs-2
Range site: Buse—Thin Upland; Sioux—Very Shallow
Windbreak suitability group: Buse—10; Sioux—10
Pasture suitability group: Buse—NS; Sioux—NS

Ca—Cavour-Ferney loams

Composition

Cavour and similar soils: 50 to 60 percent
Ferney and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Cavour—summits and back slopes; Ferney—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 600 acres

Typical Profile

Cavour

Surface layer:
0 to 9 inches—dark gray loam

Subsurface layer:
9 to 13 inches—gray loam

Subsoil:
13 to 18 inches—dark grayish brown clay
18 to 30 inches—dark grayish brown clay that has gypsum crystals and other salts
30 to 44 inches—light brownish gray, mottled, calcareous clay loam

Underlying layer:
44 to 56 inches—light brownish gray, mottled, calcareous clay loam
56 to 60 inches—pale olive, mottled, calcareous clay loam

Ferney

Surface layer:
0 to 4 inches—gray loam

Subsoil:
4 to 9 inches—dark gray clay
9 to 12 inches—dark grayish brown clay that has masses of salt
12 to 18 inches—grayish brown, calcareous clay that has masses of salt
18 to 48 inches—light brownish gray and light yellowish brown, calcareous clay loam that has masses of salt

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 3.5 to 5.0 feet

Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Cavour—moderate; Ferney—moderately low
Surface runoff: Slow
Other properties: Both soils have a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• Cresbard soils, which have a subsoil that is only slightly affected by sodium; on the lower back slopes
• The poorly drained Tonka soils in basins
• The well drained Forman soils, which do not have a sodium-affected subsoil; on summits and back slopes
• The calcareous, somewhat poorly drained Hamerly soils, which do not have a sodium-affected subsoil; on foot slopes

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Cavour—alfalfa, barley, oats, spring wheat, sunflowers, and winter wheat; Ferney—generally unsuited to crops
Suitability for cropland: Poorly suited
Management concerns: A slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, tilling in a timely manner, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Cavour—IVs-2; Ferney—VIs-1
Range site: Cavour—Claypan; Ferney—Thin Claypan
Windbreak suitability group: Cavour—9; Ferney—10
Pasture suitability group: Cavour—C; Ferney—NS

CbA—Clarno-Bonilla loams, 0 to 2 percent slopes

Composition

Clarno and similar soils: 50 to 65 percent
Bonilla and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Clarno—summits and back slopes; Bonilla—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 80 acres

Typical Profile

Clarno

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 14 inches—dark grayish brown loam
14 to 21 inches—brown loam
21 to 38 inches—pale brown, calcareous loam
Underlying layer:
38 to 60 inches—pale yellow, mottled, calcareous loam

Bonilla

Surface soil:
0 to 13 inches—dark gray loam
Subsoil:
13 to 27 inches—dark gray loam
27 to 35 inches—light brownish gray, calcareous loam
Underlying layer:
35 to 44 inches—light brownish gray, mottled, calcareous loam
44 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Clarno—well drained; Bonilla—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Clarno—greater than 6 feet; Bonilla—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Clarno—moderate; Bonilla—high
Surface runoff: Slow
Other properties: Runoff water flows over the Bonilla soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The calcareous Ethan soils on shoulder slopes
• The poorly drained Tetonka soils in basins
• The somewhat poorly drained Crossplain soils on toe slopes

Similar inclusions:
• Soils that have more clay in the subsoil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface conserve moisture.

Interpretive Groups

Land capability classification: Clarno—IIc-2; Bonilla—IIc-3
Range site: Clarno—Silty; Bonilla—Loamy Overflow
Windbreak suitability group: Clarno—3; Bonilla—1
Pasture suitability group: Clarno—F; Bonilla—K

CbB—Clarno-Bonilla loams, 1 to 6 percent slopes

Composition

Clarno and similar soils: 40 to 55 percent
Bonilla and similar soils: 35 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Clarno—summits and back slopes; Bonilla—foot slopes
Slope range: Clarno—2 to 6 percent; Bonilla—1 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Clarno

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 14 inches—dark grayish brown loam
14 to 21 inches—brown loam
21 to 38 inches—pale brown, calcareous loam
Underlying layer:
38 to 60 inches—pale yellow, mottled, calcareous loam

Bonilla

Surface soil:
0 to 13 inches—dark gray loam
Subsoil:
13 to 27 inches—dark gray loam
27 to 35 inches—light brownish gray, calcareous loam
Underlying layer:
35 to 44 inches—light brownish gray, mottled, calcareous loam
44 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Clarno—well drained; Bonilla—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Clarno—greater than 6 feet; Bonilla—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Clarno—moderate; Bonilla—high
Surface runoff: Clarno—medium; Bonilla—slow
Other properties: Runoff water flows over the Bonilla soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The well drained Ethan soils, which are calcareous at or near the surface; on shoulder slopes
• The poorly drained Tetonka soils in basins
• The somewhat poorly drained Crossplain soils on toe slopes

Similar inclusions:
• Soils that have more clay in the subsoil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Clarno—water erosion; Bonilla—conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular to be farmed on the contour.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Clarno—IIe-2; Bonilla—IIc-3
Range site: Clarno—Silty; Bonilla—Loamy Overflow
Windbreak suitability group: Clarno—3; Bonilla—1
Pasture suitability group: Clarno—F; Bonilla—K

CeB—Clarno-Ethan-Bonilla loams, 1 to 6 percent slopes

Composition

Clarno and similar soils: 35 to 50 percent
Ethan and similar soils: 20 to 35 percent
Bonilla and similar soils: 15 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Clarno—summits and back slopes; Ethan—shoulder slopes; Bonilla—foot slopes
Slope range: Clarno—2 to 6 percent; Ethan—2 to 6 percent; Bonilla—1 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 400 acres

Typical Profile

Clarno

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 14 inches—dark grayish brown loam
14 to 21 inches—brown loam
21 to 38 inches—pale brown, calcareous loam
Underlying layer:
38 to 60 inches—pale yellow, mottled, calcareous loam

Ethan

Surface layer:
0 to 9 inches—dark grayish brown, calcareous loam
Subsoil:
9 to 30 inches—very pale brown, calcareous loam
Underlying layer:
30 to 45 inches—pale yellow, mottled, calcareous loam
45 to 60 inches—light yellowish brown, mottled, calcareous loam

Bonilla

Surface soil:
0 to 13 inches—dark gray loam
Subsoil:
13 to 27 inches—dark gray loam
27 to 35 inches—light brownish gray, calcareous loam
Underlying layer:
35 to 44 inches—light brownish gray, mottled, calcareous loam
44 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Clarno—well drained; Ethan—well drained; Bonilla—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Clarno—greater than 6 feet; Ethan—greater than 6 feet; Bonilla—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Clarno—moderate; Ethan—moderately low; Bonilla—high
Surface runoff: Clarno—medium; Ethan—medium; Bonilla—slow
Other properties: Runoff water flows over the Bonilla soil during periods of rainfall or snowmelt. The Ethan soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The poorly drained Tetonka soils in basins
• The somewhat poorly drained Crossplain soils on toe slopes
Similar inclusions:
• Soils that have more clay in the subsoil than the Clarno and Bonilla soils

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Clarno—water erosion; Ethan—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Bonilla—conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular to be farmed on the contour.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to

control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Clarno—IIe-2; Ethan—IIIe-12; Bonilla—IIc-3
Range site: Clarno—Silty; Ethan—Thin Upland; Bonilla—Loamy Overflow
Windbreak suitability group: Clarno—3; Ethan—8; Bonilla—1
Pasture suitability group: Clarno—F; Ethan—G; Bonilla—K

CeC—Clarno-Ethan-Bonilla loams, 2 to 9 percent slopes

Composition

Clarno and similar soils: 35 to 50 percent
Ethan and similar soils: 25 to 35 percent
Bonilla and similar soils: 15 to 25 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Clarno—back slopes; Ethan—shoulder slopes; Bonilla—foot slopes
Slope range: Clarno—6 to 9 percent; Ethan—6 to 9 percent; Bonilla—2 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 80 acres

Typical Profile

Clarno

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 14 inches—dark grayish brown loam
14 to 21 inches—brown loam
21 to 38 inches—pale brown, calcareous loam
Underlying layer:
38 to 60 inches—pale yellow, mottled, calcareous loam

Ethan

Surface layer:
0 to 9 inches—dark grayish brown, calcareous loam
Subsoil:
9 to 30 inches—very pale brown, calcareous loam
Underlying layer:
30 to 45 inches—pale yellow, mottled, calcareous loam
45 to 60 inches—light yellowish brown, mottled, calcareous loam

Bonilla

Surface soil:
0 to 13 inches—dark gray loam
Subsoil:
13 to 27 inches—dark gray loam
27 to 35 inches—light brownish gray, calcareous loam
Underlying layer:
35 to 44 inches—light brownish gray, calcareous loam
44 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Clarno—well drained; Ethan—well drained; Bonilla—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Clarno—greater than 6 feet; Ethan—greater than 6 feet; Bonilla—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Clarno—moderate; Ethan—moderately low; Bonilla—high
Surface runoff: Medium
Other properties: Runoff water flows over the Bonilla soil during periods of rainfall or snowmelt. The Ethan soil has a high content of lime.

Inclusions

Contrasting inclusions:
- The somewhat poorly drained Crossplain soils on toe slopes
- The poorly drained Tetonka soils in basins

Similar inclusions:
- Soils that have more clay in the subsoil than the Clarno soil
- Soils that have a thinner surface layer than the Ethan soil
- Soils that have more clay in the subsoil than the Bonilla soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, spring wheat, and sunflowers
Suitability for cropland: Fairly well suited
Management concerns: Clarno—water erosion; Ethan—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Bonilla—water erosion

Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming, terraces, and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular for terraces or for contour farming.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Clarno—IIIe-2; Ethan—IVe-3; Bonilla—IIe-3
Range site: Clarno—Silty; Ethan—Thin Upland; Bonilla—Silty
Windbreak suitability group: Clarno—3; Ethan—8; Bonilla—1
Pasture suitability group: Clarno—F; Ethan—G; Bonilla—K

Co—Colvin silty clay loam

Composition

Colvin and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Lake plains
Position on the landform: Toe slopes
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 40 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—dark gray, calcareous silty clay loam
Subsoil:
8 to 26 inches—light gray, calcareous silt loam
26 to 47 inches—light gray, mottled, calcareous silt loam
Underlying layer:
47 to 60 inches—light yellowish brown, mottled, calcareous loamy very fine sand

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over finer or coarser material
Seasonal high water table: 1 foot above to 1 foot below the surface
Flooding: None
Ponding: Occasional for long periods
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Very slow
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The very poorly drained Oldham and Southam soils in basins
• The somewhat poorly drained Cubden soils on foot slopes
• The somewhat poorly drained Mauvais soils, which are less calcareous in the surface layer and subsoil than the Colvin soil; on toe slopes

Similar inclusions:
• Soils that have more sand and less silt throughout

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Barley, soybeans, oats, and spring wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness; wind erosion; the high content of lime, which adversely affects the availability of plant nutrients; and surface compaction if tilled when wet
Management measures:
• In most years this soil is better suited to late planted crops than to other crops.
• Deferring tillage when the soil is wet helps to prevent surface compaction.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-3
Range site: Wetland
Windbreak suitability group: 10
Pasture suitability group: B1

Cr—Cresbard-Cavour loams

Composition

Cresbard and similar soils: 50 to 60 percent
Cavour and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Cresbard—summits and back slopes; Cavour—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 100 acres

Typical Profile

Cresbard

Surface layer:
0 to 9 inches—dark gray loam
Subsurface layer:
9 to 10 inches—gray loam
Transitional layer:
10 to 14 inches—gray and dark gray clay loam
Subsoil:
14 to 34 inches—dark gray and grayish brown silty clay
34 to 55 inches—grayish brown, mottled, calcareous clay loam
Underlying layer:
55 to 60 inches—light brownish gray, mottled, calcareous clay loam

Cavour

Surface layer:
0 to 9 inches—dark gray loam
Subsurface layer:
9 to 13 inches—gray loam
Subsoil:
13 to 18 inches—dark grayish brown clay
18 to 30 inches—dark grayish brown clay that has gypsum crystals and other salts
30 to 44 inches—light brownish gray, mottled, calcareous clay loam
Underlying layer:
44 to 56 inches—light brownish gray, mottled, calcareous clay loam
56 to 60 inches—pale olive, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Cresbard—slow; Cavour—very slow
Available water capacity: Cresbard—high; Cavour—moderate
Organic matter content: Moderate
Surface runoff: Slow
Other properties: A sodium-affected subsoil restricts root growth and the rate of water infiltration in both soils.

Inclusions

Contrasting inclusions:
• The moderately well drained Ferney soils, which have sodium salts above a depth of 16 inches; on foot slopes
• The well drained Forman soils, which do not have a sodium-affected subsoil; on back slopes
• The poorly drained Harriet soils on low flood plains
• The calcareous Hamerly soils, which do not have a sodium-affected subsoil; on foot slopes

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: A slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Leaving crop residue on the surface, minimizing tillage, tilling in a timely manner, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Cresbard—IIIs-1; Cavour—IVs-2
Range site: Cresbard—Clayey; Cavour—Claypan
Windbreak suitability group: Cresbard—4; Cavour—9
Pasture suitability group: Cresbard—E; Cavour—C

Ct—Crossplain-Tetonka complex

Composition

Crossplain and similar soils: 55 to 65 percent
Tetonka and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Till plains
Position on the landform: Crossplain—toe slopes; Tetonka—basins
Slope range: Crossplain—0 to 2 percent; Tetonka—0 to 1 percent
Shape of areas: Irregular
Size of areas: 5 to 40 acres

Typical Profile

Crossplain

Surface layer:
0 to 9 inches—dark gray clay loam

Subsoil:
9 to 22 inches—dark gray clay
22 to 34 inches—olive gray clay
34 to 54 inches—gray and light gray, mottled, calcareous clay loam

Underlying layer:
54 to 60 inches—gray and light gray, mottled, calcareous clay loam

Tetonka

Surface layer:
0 to 7 inches—gray silt loam

Subsurface layer:
7 to 12 inches—gray, mottled silt loam

Subsoil:
12 to 33 inches—dark gray silty clay
33 to 44 inches—light brownish gray, mottled, calcareous clay loam

Underlying layer:
44 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Crossplain—somewhat poorly drained; Tetonka—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: Crossplain—at the surface to 2 feet below the surface; Tetonka—1 foot above to 1 foot below the surface
Flooding: Crossplain—frequent for brief periods; Tetonka—none
Ponding: Crossplain—none; Tetonka—frequent for long periods
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Crossplain—very slow; Tetonka—negligible

Inclusions

Contrasting inclusions:
• The well drained Clarno soils on back slopes
• The moderately well drained Davison soils, which are calcareous at or near the surface; on foot slopes

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Crossplain—alfalfa, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat; Tetonka—corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Wetness
Management measures:
• In wet years these soils are better suited to late planted crops than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to maintain tilth and increase the rate of water infiltration.
• Deferring tillage when these soils are wet helps to prevent surface compaction.

Interpretive Groups

Land capability classification: Crossplain—IIw-1; Tetonka—IVw-1
Range site: Crossplain—Loamy Overflow; Tetonka—Wet Meadow
Windbreak suitability group: Crossplain—2; Tetonka—10
Pasture suitability group: Crossplain—A; Tetonka—B2

Cu—Cubden silty clay loam

Composition

Cubden and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark gray, calcareous silty clay loam

Subsurface layer:
10 to 14 inches—gray, calcareous silty clay loam

Subsoil:
14 to 22 inches—light gray, calcareous silty clay loam
22 to 28 inches—light gray, calcareous silt loam

Underlying layer:
28 to 50 inches—pale yellow, mottled, calcareous silt loam
50 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over loamy glacial till
Depth to the water table: 1.5 to 3.5 feet
Flooding: None
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The poorly drained Colvin soils on toe slopes
• The well drained Kranzburg and Poinsett soils, which are not calcareous at or near the surface; on back slopes
• The poorly drained Tonka soils, which are not calcareous at or near the surface; in basins

Similar inclusions:
• Soils that have more sand and less silt
• Soils that have gravelly material within a depth of 40 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Wind erosion and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: IIs-4
Range site: Limy Subirrigated
Windbreak suitability group: 1
Pasture suitability group: F

Cv—Cubden-Badger silty clay loams

Composition

Cubden and similar soils: 45 to 60 percent
Badger and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Cubden—foot slopes; Badger—toe slopes
Slope range: Cubden—0 to 2 percent; Badger—0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 40 acres

Typical Profile

Cubden

Surface layer:
0 to 10 inches—very dark gray, calcareous silty clay loam

Subsurface layer:
10 to 14 inches—gray, calcareous silty clay loam

Subsoil:
14 to 22 inches—light gray, calcareous silty clay loam
22 to 28 inches—light gray, calcareous silt loam

Underlying layer:
28 to 50 inches—pale yellow, mottled, calcareous silt loam
50 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Badger

Surface soil:
0 to 15 inches—dark gray silty clay loam

Subsoil:
15 to 30 inches—dark gray and gray silty clay loam
30 to 38 inches—light brownish gray, mottled silty clay loam

Underlying layer:
38 to 60 inches—light gray, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Cubden—40 to more than 60 inches over loamy glacial till; Badger—40 to more than 60 inches over glacial till
Seasonal high water table: Cubden—at a depth of 1.5 to 3.5 feet; Badger—at the surface to 3 feet below the surface
Flooding: Cubden—none; Badger—frequent for brief periods

Ponding: None
Permeability: Cubden—moderate; Badger—slow
Available water capacity: High
Organic matter content: Cubden—moderate; Badger—high
Surface runoff: Cubden—slow; Badger—very slow
Other properties: The Cubden soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The poorly drained Colvin soils on toe slopes
• The well drained Kranzburg and Poinsett soils on back slopes
• The poorly drained Tonka soils in basins
• The moderately well drained Waubay soils on foot slopes

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Cubden—wind erosion and the high content of lime, which adversely affects the availability of plant nutrients; Badger—wetness
Management measures:
• In wet years these soils are better suited to late planted crops than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Deferring tillage and grazing on the Badger soil during wet periods helps to prevent surface compaction.

Interpretive Groups

Land capability classification: Cubden—IIs-4; Badger—IIw-1
Range site: Cubden—Limy Subirrigated; Badger—Loamy Overflow
Windbreak suitability group: Cubden—1; Badger—2
Pasture suitability group: Cubden—F; Badger—A

Cw—Cubden-Tonka silty clay loams

Composition

Cubden and similar soils: 50 to 65 percent
Tonka and similar soils: 25 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Cubden—foot slopes; Tonka—basins
Slope range: Cubden—0 to 2 percent; Tonka—0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 40 acres

Typical Profile

Cubden

Surface layer:
0 to 10 inches—very dark gray, calcareous silty clay loam

Subsurface layer:
10 to 14 inches—gray, calcareous silty clay loam

Subsoil:
14 to 22 inches—light gray, calcareous silty clay loam
22 to 28 inches—light gray, calcareous silt loam

Underlying layer:
28 to 50 inches—pale yellow, mottled, calcareous silt loam
50 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Tonka

Surface layer:
0 to 14 inches—dark gray silty clay loam

Subsurface layer:
14 to 24 inches—gray, mottled silt loam

Subsoil:
24 to 46 inches—dark gray, mottled silty clay loam
46 to 53 inches—grayish brown, mottled silty clay loam

Underlying layer:
53 to 60 inches—light brownish gray, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Cubden—somewhat poorly drained; Tonka—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Cubden—40 to more than 60 inches over loamy glacial till; Tonka—greater than 60 inches
Seasonal high water table: Cubden—at a depth of 1.5 to 3.5 feet; Tonka—0.5 foot above to 1.0 foot below the surface
Flooding: None
Ponding: Cubden—none; Tonka—frequent for long periods
Permeability: Cubden—moderate; Tonka—slow
Available water capacity: High

Organic matter content: Cubden—moderate; Tonka—high
Surface runoff: Cubden—slow; Tonka—negligible
Other properties: The Cubden soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Badger soils, which have more clay in the subsoil than the Cubden soil; on toe slopes
• Waubay soils, which are not calcareous at or near the surface; on foot slopes

Similar inclusions:
• Soils that have more sand and less silt than the Cubden soil
• Soils that have clay loam glacial till at a depth of 24 to 40 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Cubden—alfalfa, barley, corn, oats, soybeans, and spring wheat; Tonka—barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Cubden—wind erosion and the high content of lime, which adversely affects the availability of plant nutrients; Tonka—wetness, surface compaction if tilled when wet
Management measures:
• In wet years these soils are better suited to late planted crops than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Deferring tillage when the Tonka soil is wet helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: Cubden—IIs-4; Tonka—IVw-2
Range site: Cubden—Limy Subirrigated; Tonka—Wet Meadow
Windbreak suitability group: Cubden—1; Tonka—10
Pasture suitability group: Cubden—F; Tonka—B2

Da—Davison-Crossplain complex

Composition

Davison and similar soils: 55 to 65 percent
Crossplain and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Till plains
Position on the landform: Davison—foot slopes; Crossplain—toe slopes
Slope range: Davison—0 to 2 percent; Crossplain—0 to 1 percent
Shape of areas: Irregular
Size of areas: 5 to 40 acres

Typical Profile

Davison

Surface layer:
0 to 9 inches—dark gray, calcareous loam
Subsoil:
9 to 16 inches—light brownish gray, calcareous loam
16 to 33 inches—light yellowish brown, calcareous loam
Underlying layer:
33 to 60 inches—light gray, mottled, calcareous clay loam

Crossplain

Surface layer:
0 to 9 inches—dark gray clay loam
Subsoil:
9 to 22 inches—dark gray clay
22 to 34 inches—olive gray clay
34 to 54 inches—gray and light gray, mottled, calcareous clay loam
Underlying layer:
54 to 60 inches—gray and light gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Davison—moderately well drained; Crossplain—somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: Davison—at a depth of 1.5 to 4.0 feet; Crossplain—at the surface to 2.0 feet below the surface
Flooding: Davison—none; Crossplain—frequent for brief periods
Ponding: None
Permeability: Davison—moderately slow; Crossplain—slow
Available water capacity: High
Organic matter content: Davison—moderate; Crossplain—high

Surface runoff: Davison—slow; Crossplain—very slow
Other properties: The Davison soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The moderately well drained Bonilla soils, which are not calcareous in the upper layers; on foot slopes
• The well drained Clarno soils on back slopes
• The poorly drained Tetonka soils in basins

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Davison—wind erosion and the high content of lime, which adversely affects the availability of plant nutrients; Crossplain—wetness, surface compaction if tilled when wet
Management measures:
• In wet years these soils are better suited to late planted crops than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Deferring tillage when the Crossplain soil is wet helps to prevent surface compaction.

Interpretive Groups

Land capability classification: Davison—IIe-4; Crossplain—IIw-1
Range site: Davison—Limy Subirrigated; Crossplain—Loamy Overflow
Windbreak suitability group: Davison—1; Crossplain—2
Pasture suitability group: Davison—F; Crossplain—A

DeA—Delmont-Enet loams, 0 to 2 percent slopes

Composition

Delmont and similar soils: 45 to 60 percent
Enet and similar soils: 30 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Delmont—summits and back slopes; Enet—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 40 acres

Typical Profile

Delmont

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 16 inches—very dark grayish brown loam
Underlying layer:
16 to 22 inches—grayish brown, calcareous gravelly loamy sand
22 to 60 inches—light olive brown, calcareous gravelly loamy sand

Enet

Surface layer:
0 to 7 inches—dark grayish brown loam
Subsoil:
7 to 18 inches—dark grayish brown loam
18 to 22 inches—brown loam
22 to 25 inches—brown sandy loam
Underlying layer:
25 to 31 inches—yellowish brown, calcareous gravelly sand
31 to 60 inches—brown and light brownish gray, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Delmont—somewhat excessively drained; Enet—well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Delmont—14 to 20 inches over gravelly material; Enet—20 to 40 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Delmont—low; Enet—moderate
Organic matter content: Moderate
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• Clarno soils, which do not have gravelly underlying material; in positions on the landscape similar to those of the Delmont soil
• Henkin soils, which have more sand in the surface

layer and subsoil and less gravel in the underlying material than the Delmont soil; in positions on the landscape similar to those of the Delmont soil

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Poorly suited
Management concerns: Delmont—low available water capacity; Enet—moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Irrigation helps to overcome the limited available water capacity if water is of adequate quantity and quality.

Interpretive Groups

Land capability classification: Delmont—IVs-1; Enet—IIIs-2
Range site: Delmont—Shallow to Gravel; Enet—Silty
Windbreak suitability group: Delmont—6; Enet—6
Pasture suitability group: Delmont—D2; Enet—D1

DeB—Delmont-Enet loams, 2 to 6 percent slopes

Composition

Delmont and similar soils: 50 to 60 percent
Enet and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Delmont—summits and back slopes; Enet—foot slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 40 acres

Typical Profile

Delmont

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 16 inches—very dark grayish brown loam
Underlying layer:
16 to 22 inches—grayish brown, calcareous gravelly loamy sand
22 to 60 inches—light olive brown, calcareous gravelly loamy sand

Enet

Surface layer:
0 to 7 inches—dark grayish brown loam
Subsoil:
7 to 18 inches—dark grayish brown loam
18 to 22 inches—brown loam
22 to 25 inches—brown sandy loam
Underlying layer:
25 to 31 inches—yellowish brown, calcareous gravelly sand
31 to 60 inches—brown and light brownish gray, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Delmont—somewhat excessively drained; Enet—well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Delmont—14 to 20 inches over gravelly material; Enet—20 to 40 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Delmont—low; Enet—moderate
Organic matter content: Moderate
Surface runoff: Medium

Inclusions

Contrasting inclusions:
• Clarno soils, which do not have gravelly underlying material; in positions on the landscape similar to those of the Delmont soil
• Henkin soils, which have more sand in the surface layer and subsoil and less gravel in the underlying material than the Delmont soil; in positions on the landscape similar to those of the Delmont soil

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Poorly suited
Management concerns: Delmont—water erosion, low available water capacity; Enet—water erosion,

moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Irrigation helps to overcome the limited available water capacity if water is of adequate quantity and quality.

Interpretive Groups

Land capability classification: Delmont—IVe-6; Enet—IIIe-6
Range site: Delmont—Shallow to Gravel; Enet—Silty
Windbreak suitability group: Delmont—6; Enet—6
Pasture suitability group: Delmont—D2; Enet—D1

Dm—Dimo loam

Composition

Dimo and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Flood plains
Position on the landform: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 10 acres

Typical Profile

Surface soil:
0 to 12 inches—dark gray loam
Subsoil:
12 to 15 inches—dark gray clay loam
15 to 22 inches—dark grayish brown clay loam
22 to 28 inches—grayish brown, calcareous clay loam
Underlying layer:
28 to 60 inches—grayish brown, mottled, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 20 to 40 inches over gravelly material
Depth to the water table: 1.5 to 3.5 feet
Flooding: Occasional for brief periods
Ponding: None
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The well drained Bon soils, which do not have gravelly material above a depth of 40 inches; on high flood plains
• The poorly drained Lamo soils, which do not have gravelly material within a depth of 40 inches; on low flood plains
• The well drained Delmont soils on summits and back slopes
Similar inclusions:
• Soils that are poorly drained
• Soils that are well drained

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Moderate available water capacity
Management measures:
• This soil is better suited to early maturing crops than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Irrigation helps to overcome the limited available water capacity if water is of adequate quantity and quality.

Interpretive Groups

Land capability classification: IIIs-2
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: K

Dv—Divide loam

Composition

Divide and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular

Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark gray, calcareous loam

Subsoil:
10 to 21 inches—light gray, calcareous loam
21 to 28 inches—white, mottled, calcareous loam
28 to 37 inches—light gray, mottled, calcareous loam

Underlying layer:
37 to 60 inches—light gray, mottled, calcareous extremely gravelly loamy sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 20 to 40 inches over gravelly material
Depth to the water table: 1.5 to 3.5 feet
Flooding: None
Ponding: None
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Slow
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The well drained Fordville and somewhat excessively drained Renshaw soils, which are calcareous at a greater depth than the Divide soil; on back slopes and foot slopes along the edges of the mapped areas
• The poorly drained Marysland soils on low flood plains

Similar inclusions:
• Soils that have loamy glacial till below a depth of 40 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Wind erosion, the moderate available water capacity, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: IIIs-4
Range site: Limy Subirrigated
Windbreak suitability group: 1
Pasture suitability group: D1

Dx—Dudley-Jerauld silt loams

Composition

Dudley and similar soils: 50 to 60 percent
Jerauld and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Dudley—summits and back slopes; Jerauld—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 300 acres

Typical Profile

Dudley

Surface layer:
0 to 8 inches—dark gray silt loam

Subsurface layer:
8 to 11 inches—gray silt loam

Subsoil:
11 to 28 inches—dark gray clay
28 to 34 inches—very dark gray clay that has nests of salt
34 to 42 inches—light brownish gray, calcareous silty clay that has nests of gypsum and other salts
42 to 50 inches—light yellowish brown, mottled, calcareous clay loam

Underlying layer:
50 to 60 inches—olive gray, mottled, calcareous clay loam

Jerauld

Surface layer:
0 to 3 inches—dark gray and gray silt loam

Subsoil:
3 to 8 inches—dark gray clay
8 to 13 inches—grayish brown clay with masses of salt
13 to 20 inches—light brownish gray, calcareous clay loam that has gypsum crystals and other salts

20 to 31 inches—light olive brown, calcareous clay loam that has gypsum crystals

Underlying layer:

31 to 36 inches—light yellowish brown, calcareous silty clay that has gypsum crystals and other salts

36 to 60 inches—light gray and light brownish gray, calcareous clay loam that is mottled in the lower part

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Dudley—high; Jerauld—moderate
Organic matter content: Moderate
Surface runoff: Slow
Other properties: Both soils have a sodium-affected subsoil.

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Crossplain soils on toe slopes
- The well drained Houdek soils, which do not have a sodium-affected subsoil; on summits and back slopes
- The moderately well drained Stickney soils, which have less sodium in the subsoil than the major soils; on summits and back slopes
- The poorly drained Tetonka soils in basins

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Dudley—alfalfa, barley, oats, spring wheat, sunflowers, and winter wheat; Jerauld—generally unsuited to crops
Suitability for cropland: Poorly suited
Management concerns: A slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:

- Minimizing tillage, leaving crop residue on the surface, tilling in a timely manner, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
- Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Dudley—IVs-2; Jerauld—VIs-1
Range site: Dudley—Claypan; Jerauld—Thin Claypan
Windbreak suitability group: Dudley—9; Jerauld—10
Pasture suitability group: Dudley—C; Jerauld—NS

Dy—Durrstein silt loam

Composition

Durrstein and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 5 to 20 acres

Typical Profile

Surface layer:

0 to 2 inches—gray silt loam

Subsoil:

2 to 12 inches—dark gray silty clay
12 to 19 inches—dark gray, calcareous silty clay
19 to 45 inches—light brownish gray, calcareous clay loam that has nests of salts

Underlying layer:

45 to 60 inches—olive gray, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over sandy material
Seasonal high water table: At the surface to 1.5 feet below the surface
Flooding: Frequent for brief periods
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Very slow
Other properties: This soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:

- The somewhat poorly drained Lamo soils, which do not have a sodium-affected subsoil; in the slightly higher positions on the landscape
- The somewhat poorly drained Farmsworth soils, which have a thicker surface layer than the Durrstein soil and

are less affected by sodium; in the slightly higher positions on the landscape
• Salmo soils, which do not have a sodium-affected subsoil; on low flood plains

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Wetness, a slow rate of water infiltration, and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Proper grazing management maintains plant vigor.
• Restricting grazing during wet periods helps to prevent surface compaction.

Interpretive Groups

Land capability classification: VIs-6
Range site: Saline Lowland
Windbreak suitability group: 10
Pasture suitability group: J

EgA—Egeland-Embden complex, 0 to 2 percent slopes

Composition

Egeland and similar soils: 40 to 60 percent
Embden and similar soils: 30 to 50 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Egeland—summits and back slopes; Embden—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Egeland

Surface layer:
0 to 8 inches—very dark gray sandy loam

Subsoil:
8 to 15 inches—dark grayish brown fine sandy loam
15 to 21 inches—brown sandy loam
21 to 29 inches—very pale brown, calcareous fine sandy loam

Underlying layer:
29 to 48 inches—pale brown, mottled, calcareous fine sandy loam
48 to 60 inches—light yellowish brown, mottled, calcareous loamy fine sand

Embden

Surface layer:
0 to 8 inches—dark gray fine sandy loam

Subsurface layer:
8 to 16 inches—dark gray loam

Subsoil:
16 to 30 inches—dark grayish brown sandy loam
30 to 37 inches—brown sandy loam
37 to 49 inches—pale brown, mottled, calcareous sandy loam
49 to 53 inches—light gray, mottled, calcareous very fine sandy loam

Underlying layer:
53 to 60 inches—light yellowish brown, calcareous loamy sand

Soil Properties and Qualities

Drainage class: Egeland—well drained; Embden—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Egeland—40 to more than 60 inches over glacial till; Embden—40 to more than 60 inches over finer or coarser material
Depth to the water table: Egeland—greater than 6 feet; Embden—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately rapid
Available water capacity: Moderate
Organic matter content: Egeland—moderate; Embden—high
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• Poinsett soils, which have more silt and clay than the Egeland soil; on back slopes along the edges of the mapped areas
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes

Similar inclusions:
• Soils that have silty and loamy material within a depth of 40 inches

Use and Management

Dominant land use: Cropland

Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Wind erosion, moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and maintain the content of organic matter.
• Wind stripcropping and field windbreaks help to control wind erosion.

Interpretive Groups

Land capability classification: Egeland—IIIs-1; Embden—IIs-5
Range site: Egeland—Sandy; Embden—Sandy
Windbreak suitability group: Egeland—5; Embden—1
Pasture suitability group: Egeland—H; Embden—H

EgB—Egeland-Embden complex, 2 to 6 percent slopes

Composition

Egeland and similar soils: 50 to 65 percent
Embden and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Egeland—summits and back slopes; Embden—foot slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Egeland

Surface layer:
0 to 8 inches—very dark gray sandy loam

Subsoil:
8 to 15 inches—dark grayish brown fine sandy loam
15 to 21 inches—brown sandy loam
21 to 29 inches—very pale brown, calcareous fine sandy loam

Underlying layer:
29 to 48 inches—pale brown, mottled, calcareous fine sandy loam
48 to 60 inches—light yellowish brown, mottled, calcareous loamy fine sand

Embden

Surface layer:
0 to 8 inches—dark gray fine sandy loam

Subsurface layer:
8 to 16 inches—dark gray loam

Subsoil:
16 to 30 inches—dark grayish brown sandy loam
30 to 37 inches—brown sandy loam
37 to 49 inches—pale brown, mottled, calcareous sandy loam
49 to 53 inches—light gray, mottled, calcareous very fine sandy loam

Underlying layer:
53 to 60 inches—light yellowish brown, calcareous loamy sand

Soil Properties and Qualities

Drainage class: Egeland—well drained; Embden—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Egeland—40 to more than 60 inches over glacial till; Embden—40 to more than 60 inches over finer or coarser material
Depth to the water table: Egeland—greater than 6 feet; Embden—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately rapid
Available water capacity: Moderate
Organic matter content: Egeland—moderate; Embden—high
Surface runoff: Medium

Inclusions

Contrasting inclusions:
• Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• Poinsett soils, which have more silt and clay than the Egeland soil; on back slopes along the edges of the mapped areas
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes

Similar inclusions:
• Soils that have silty and loamy material within a depth of 40 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Wind erosion, water erosion, moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and maintain the content of organic matter.
• Wind stripcropping and field windbreaks help to control wind erosion.

Interpretive Groups

Land capability classification: Egeland—IIIe-7; Embden—IIIe-7
Range site: Egeland—Sandy; Embden—Sandy
Windbreak suitability group: Egeland—5; Embden—1
Pasture suitability group: Egeland—H; Embden—H

EoD—Ethan-Bon, channeled, loams, 0 to 20 percent slopes

Composition

Ethan and similar soils: 50 to 60 percent
Bon and similar soils: 25 to 35 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Moraines and flood plains
Position on the landform: Ethan—shoulder slopes and back slopes; Bon—low flood plains
Slope range: Ethan—9 to 20 percent; Bon—0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 5 to 100 acres

Typical Profile

Ethan

Surface layer:
0 to 9 inches—dark grayish brown, calcareous loam
Subsoil:
9 to 30 inches—very pale brown, calcareous loam
Underlying layer:
30 to 45 inches—pale yellow, mottled, calcareous loam
45 to 60 inches—light yellowish brown, mottled, calcareous loam

Bon

Surface soil:
0 to 18 inches—dark gray and dark grayish brown loam that is calcareous in the lower part
Subsoil:
18 to 24 inches—very dark gray, calcareous loam
24 to 28 inches—dark gray, calcareous loam
28 to 48 inches—gray, calcareous loam
Underlying layer:
48 to 60 inches—dark gray, calcareous loam

Soil Properties and Qualities

Drainage class: Ethan—well drained; Bon—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Ethan—greater than 6 feet; Bon—3 to 5 feet
Flooding: Ethan—none; Bon—frequent for brief periods
Ponding: None
Permeability: Ethan—moderately slow; Bon—moderate
Available water capacity: High
Organic matter content: Ethan—moderately low; Bon—high
Surface runoff: Ethan—rapid; Bon—slow
Other properties: The Ethan soil has a high content of lime. Scattered stones are on the surface of the Ethan soil in some areas. The Bon soil typically is dissected by a meandering channel.

Inclusions

Contrasting inclusions:
• The moderately well drained Bonilla soils on foot slopes
• The well drained Clarno soils, which are calcareous below a depth of 10 inches; on back slopes
• The somewhat poorly drained Crossplain soils on toe slopes
Similar inclusions:
• Soils that have a thinner surface layer than the Ethan soil

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Ethan—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Bon—wetness and the meandering channels, which limit cultivation
Management measures:
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.

Interpretive Groups

Land capability classification: Ethan—VIe-3; Bon—VIw-1
Range site: Ethan—Thin Upland; Bon—Loamy Overflow
Windbreak suitability group: Ethan—8; Bon—1
Pasture suitability group: Ethan—G; Bon—NS

Fa—Farmsworth-Durrstein silt loams

Composition

Farmsworth and similar soils: 45 to 55 percent
Durrstein and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: Farmsworth—0 to 2 percent; Durrstein—0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 100 acres

Typical Profile

Farmsworth

Surface layer:
0 to 5 inches—dark gray silt loam

Subsurface layer:
5 to 8 inches—gray silt loam

Subsoil:
8 to 19 inches—dark gray silty clay loam
19 to 25 inches—dark gray silty clay that has nests of gypsum and other salts
25 to 43 inches—gray, calcareous silty clay loam that has nests of gypsum and other salts
43 to 52 inches—dark gray, calcareous clay loam

Underlying layer:
52 to 60 inches—gray, mottled, calcareous clay loam

Durrstein

Surface layer:
0 to 2 inches—gray silt loam

Subsoil:
2 to 12 inches—dark gray silty clay
12 to 19 inches—dark gray, calcareous silty clay
19 to 45 inches—light brownish gray, calcareous clay loam that has nests of salts

Underlying layer:
45 to 60 inches—olive gray, calcareous sandy loam

Soil Properties and Qualities

Drainage class: Farmsworth—somewhat poorly drained; Durrstein—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Farmsworth—greater than 60 inches; Durrstein—40 to more than 60 inches over sandy material
Seasonal high water table: Farmsworth—at a depth of 3 to 5 feet; Durrstein—at the surface to 1.5 feet below the surface
Flooding: Farmsworth—rare; Durrstein—frequent for brief periods
Ponding: None
Permeability: Farmsworth—slow; Durrstein—very slow
Available water capacity: Farmsworth—high; Durrstein—moderate
Organic matter content: Moderate
Surface runoff: Farmsworth—slow; Durrstein—very slow
Other properties: Both soils have a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The well drained Bon soils on high flood plains
• The poorly drained Salmo soils, which have salts at or near the surface; on low flood plains
• The calcareous Lamo soils, which do not have a sodium-affected subsoil; on low flood plains

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, barley, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness; the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration; and surface compaction if tilled when wet
Management measures:
• In most years these soils are better suited to late planted crops than to other crops.
• Leaving crop residue on the surface, deferring tillage when the soils are wet, and including grasses and legumes in the cropping system maintain tilth and help to prevent surface compaction.
• Chiseling or subsoiling when the soils are dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Farmsworth—IVs-2; Durrstein—VIs-6
Range site: Farmsworth—Claypan; Durrstein—Saline Lowland
Windbreak suitability group: Farmsworth—9; Durrstein—10
Pasture suitability group: Farmsworth—C; Durrstein—J

FdA—Fordville loam, 0 to 2 percent slopes

Composition

Fordville and similar soils: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Outwash plains
Position on the landform: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Surface layer:
0 to 7 inches—very dark gray loam
Subsoil:
7 to 24 inches—dark grayish brown loam
24 to 28 inches—brown loam
Underlying layer:
28 to 43 inches—brown, calcareous very gravelly loamy sand
43 to 60 inches—light brownish gray, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: 20 to 40 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Divide soils, which are calcareous at or near the surface; on the lower foot slopes
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes
Similar inclusions:
• Soils that have loamy glacial till above a depth of 40 inches
• Soils that have more silt and less sand in the subsoil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Moderate available water capacity
Management measures:
• This soil is better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Irrigation helps to overcome the limited available water capacity if water is of adequate quantity and quality.

Interpretive Groups

Land capability classification: IIs-3
Range site: Silty
Windbreak suitability group: 6
Pasture suitability group: D1

FmA—Forman-Aastad loams, 0 to 3 percent slopes

Composition

Forman and similar soils: 60 to 70 percent
Aastad and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Forman—summits and back slopes; Aastad—foot slopes
Slope range: Forman—0 to 3 percent; Aastad—0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Forman

Surface layer:
0 to 8 inches—dark gray loam
Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 19 inches—grayish brown, calcareous clay loam
19 to 31 inches—light brownish gray, calcareous clay loam
Underlying layer:
31 to 60 inches—light brownish gray, mottled, calcareous clay loam

Aastad

Surface soil:
0 to 18 inches—dark gray loam

Subsoil:
18 to 23 inches—dark grayish brown clay loam
23 to 32 inches—light olive brown clay loam
32 to 44 inches—light yellowish brown, calcareous clay loam

Underlying layer:
44 to 60 inches—light olive brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Forman—well drained; Aastad—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Forman—greater than 6 feet; Aastad—2.5 to 4.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: Runoff water flows over the Aastad soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The well drained Buse soils, which are calcareous at or near the surface; on shoulder slopes
• The moderately well drained Cresbard soils, which have a sodium-affected subsoil; on foot slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more clay in the subsoil than the Forman soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface conserve moisture.

Interpretive Groups

Land capability classification: Forman—IIc-2; Aastad—IIc-3
Range site: Forman—Silty; Aastad—Loamy Overflow
Windbreak suitability group: Forman—3; Aastad—1
Pasture suitability group: Forman—F; Aastad—K

FmB—Forman-Aastad loams, 1 to 6 percent slopes

Composition

Forman and similar soils: 60 to 70 percent
Aastad and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Forman—summits and back slopes; Aastad—foot slopes
Slope range: Forman—2 to 6 percent; Aastad—1 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Forman

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 19 inches—grayish brown, calcareous clay loam
19 to 31 inches—light brownish gray, calcareous clay loam

Underlying layer:
31 to 60 inches—light brownish gray, mottled, calcareous clay loam

Aastad

Surface soil:
0 to 18 inches—dark gray loam

Subsoil:
18 to 23 inches—dark grayish brown clay loam
23 to 32 inches—light olive brown clay loam
32 to 44 inches—light yellowish brown, calcareous clay loam

Underlying layer:
44 to 60 inches—light olive brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Forman—well drained; Aastad—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Forman—greater than 6 feet; Aastad—2.5 to 4.0 feet

Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Forman—medium; Aastad—slow
Other properties: Runoff water flows over the Aastad soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The well drained Buse soils, which are calcareous at or near the surface; on shoulder slopes
• The moderately well drained Cresbard soils, which have a sodium-affected subsoil; on foot slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more clay in the subsoil than the Forman soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Forman—water erosion; Aastad—conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular to be farmed on the contour.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Forman—IIe-2; Aastad—IIc-3
Range site: Forman—Silty; Aastad—Loamy Overflow
Windbreak suitability group: Forman—3; Aastad—1
Pasture suitability group: Forman—F; Aastad—K

FnB—Forman-Buse-Aastad loams, 1 to 6 percent slopes

Composition

Forman and similar soils: 30 to 50 percent
Buse and similar soils: 20 to 30 percent
Aastad and similar soils: 15 to 30 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Till plains
Position on the landform: Forman—summits and back slopes; Buse—shoulder slopes; Aastad—foot slopes
Slope range: Forman—2 to 6 percent; Buse—3 to 6 percent; Aastad—1 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 300 acres

Typical Profile

Forman

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 19 inches—grayish brown, calcareous clay loam
19 to 31 inches—light brownish gray, calcareous clay loam

Underlying layer:
31 to 60 inches—light brownish gray, mottled, calcareous clay loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Aastad

Surface soil:
0 to 18 inches—dark gray loam

Subsoil:
18 to 23 inches—dark grayish brown clay loam
23 to 32 inches—light olive brown clay loam
32 to 44 inches—light yellowish brown, calcareous clay loam

Underlying layer:
44 to 60 inches—light olive brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Forman—well drained; Buse—well drained; Aastad—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Forman—greater than 6 feet; Buse—greater than 6 feet; Aastad—2.5 to 4.0 feet
Flooding: None
Ponding: None

Permeability: Moderately slow
Available water capacity: High
Organic matter content: Forman—high; Buse—moderately low; Aastad—high
Surface runoff: Forman—medium; Buse—medium; Aastad—slow
Other properties: The Buse soil has a high content of lime. Runoff water flows over the Aastad soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The moderately well drained Cavour soils, which have a sodium-affected subsoil; on the lower foot slopes
• The moderately well drained Cresbard soils, which have a sodium-affected subsoil; on the upper foot slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more clay in the subsoil than the Forman soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Forman—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Aastad—conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular to be farmed on the contour.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Forman—IIe-2; Buse—IIIe-12; Aastad—IIc-3
Range site: Forman—Silty; Buse—Thin Upland; Aastad—Loamy Overflow
Windbreak suitability group: Forman—3; Buse—8; Aastad—1
Pasture suitability group: Forman—F; Buse—G; Aastad—K

FnC—Forman-Buse-Aastad loams, 2 to 9 percent slopes

Composition

Forman and similar soils: 30 to 50 percent
Buse and similar soils: 25 to 45 percent
Aastad and similar soils: 10 to 20 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Forman—back slopes; Buse—shoulder slopes; Aastad—foot slopes
Slope range: Forman—6 to 9 percent; Buse—6 to 9 percent; Aastad—2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

Forman

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 19 inches—grayish brown, calcareous clay loam
19 to 31 inches—light brownish gray, calcareous clay loam

Underlying layer:
31 to 60 inches—light brownish gray, mottled, calcareous clay loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Aastad

Surface soil:
0 to 18 inches—dark gray loam

Subsoil:
18 to 23 inches—dark grayish brown clay loam
23 to 32 inches—light olive brown clay loam
32 to 44 inches—light yellowish brown, calcareous clay loam

Underlying layer:
44 to 60 inches—light olive brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Forman—well drained; Buse—well

drained; Aastad—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Forman—greater than 6 feet; Buse—greater than 6 feet; Aastad—2.5 to 4.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Forman—high; Buse—moderately low; Aastad—high
Surface runoff: Medium
Other properties: The Buse soil has a high content of lime. Runoff water flows over the Aastad soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The moderately well drained Cresbard soils, which have a sodium-affected subsoil; on foot slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more clay in the subsoil than the Forman soil
• Soils that have a thinner surface layer than the Buse soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Forman—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Aastad—water erosion
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming, terraces, and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular for terraces or for contour farming.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Forman—IIIe-2; Buse—IVe-3; Aastad—IIe-3
Range site: Forman—Silty; Buse—Thin Upland; Aastad—Silty
Windbreak suitability group: Forman—3; Buse—8; Aastad—1
Pasture suitability group: Forman—F; Buse—G; Aastad—F

FoA—Forman-Cresbard loams, 0 to 2 percent slopes

Composition

Forman and similar soils: 60 to 70 percent
Cresbard and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Forman—summits and back slopes; Cresbard—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Forman

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 19 inches—grayish brown, calcareous clay loam
19 to 31 inches—light brownish gray, calcareous clay loam

Underlying layer:
31 to 60 inches—light brownish gray, mottled, calcareous clay loam

Cresbard

Surface layer:
0 to 9 inches—dark gray loam

Subsurface layer:
9 to 10 inches—gray loam

Transitional layer:
10 to 14 inches—gray and dark gray clay loam

Subsoil:
14 to 34 inches—dark gray and grayish brown silty clay
34 to 55 inches—grayish brown, mottled, calcareous clay loam

Underlying layer:
55 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Forman—well drained; Cresbard—moderately well drained
Depth to bedrock: Very deep

Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Forman—greater than 6 feet; Cresbard—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Forman—moderately slow; Cresbard—slow
Available water capacity: High
Organic matter content: Forman—high; Cresbard—moderate
Surface runoff: Slow
Other properties: The Cresbard soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• Ferney soils, which have visible salts within a depth of 16 inches; on the lower foot slopes
• The moderately well drained Cavour soils, which have a sodium-affected subsoil; on foot slopes
• The somewhat poorly drained Hamerly soils, which have carbonates at or near the surface; on foot slopes around basins
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have less clay in the subsoil than the Forman soil
• Soils that have more clay throughout than the Forman soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Forman—conserving moisture; Cresbard—a slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soils are dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Forman—IIc-2; Cresbard—IIIs-1
Range site: Forman—Silty; Cresbard—Clayey
Windbreak suitability group: Forman—3; Cresbard—4
Pasture suitability group: Forman—F; Cresbard—E

FoB—Forman-Cresbard loams, 2 to 6 percent slopes

Composition

Forman and similar soils: 60 to 70 percent
Cresbard and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Forman—summits and back slopes; Cresbard—foot slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Forman

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 19 inches—grayish brown, calcareous clay loam
19 to 31 inches—light brownish gray, calcareous clay loam

Underlying layer:
31 to 60 inches—light brownish gray, mottled, calcareous clay loam

Cresbard

Surface layer:
0 to 9 inches—dark gray loam

Subsurface layer:
9 to 10 inches—gray loam

Transitional layer:
10 to 14 inches—gray and dark gray clay loam

Subsoil:
14 to 34 inches—dark gray and grayish brown silty clay
34 to 55 inches—grayish brown, mottled, calcareous clay loam

Underlying layer:
55 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Forman—well drained; Cresbard—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Forman—greater than 6 feet; Cresbard—3.5 to 5.0 feet

Flooding: None
Ponding: None
Permeability: Forman—moderately slow; Cresbard—slow
Available water capacity: High
Organic matter content: Forman—high; Cresbard—moderate
Surface runoff: Medium
Other properties: The Cresbard soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The well drained Buse soils, which are calcareous at or near the surface; on shoulder slopes
• The moderately well drained Cavour soils, which have a sodium-affected subsoil; on foot slopes
• Ferney soils, which have visible salts within a depth of 16 inches; on the lower foot slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have less clay in the subsoil than the Forman soil
• Soils that have more clay throughout than the Forman soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Forman—water erosion; Cresbard—water erosion, a slow rate of water infiltration, and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soils are dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Forman—IIe-2; Cresbard—IIIe-15
Range site: Forman—Silty; Cresbard—Clayey
Windbreak suitability group: Forman—3; Cresbard—4
Pasture suitability group: Forman—F; Cresbard—E

Ft—Forman-Cresbard-Tonka complex

Composition

Forman and similar soils: 40 to 55 percent
Cresbard and similar soils: 20 to 30 percent
Tonka and similar soils: 10 to 20 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Forman—back slopes; Cresbard—foot slopes; Tonka—basins
Slope range: Forman—0 to 2 percent; Cresbard—0 to 2 percent; Tonka—0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Forman

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 19 inches—grayish brown, calcareous clay loam
19 to 31 inches—light brownish gray, calcareous clay loam

Underlying layer:
31 to 60 inches—light brownish gray, mottled, calcareous clay loam

Cresbard

Surface layer:
0 to 9 inches—dark gray loam

Subsurface layer:
9 to 10 inches—gray loam

Transitional layer:
10 to 14 inches—gray and dark gray clay loam

Subsoil:
14 to 34 inches—dark gray and grayish brown silty clay
34 to 55 inches—grayish brown, mottled, calcareous clay loam

Underlying layer:
55 to 60 inches—light brownish gray, mottled, calcareous clay loam

Tonka

Surface layer:
0 to 14 inches—dark gray silty clay loam

Subsurface layer:
14 to 24 inches—gray, mottled silt loam

Subsoil:
24 to 46 inches—dark gray, mottled silty clay loam
46 to 53 inches—grayish brown, mottled silty clay loam

Underlying layer:
53 to 60 inches—light brownish gray, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Forman—well drained; Cresbard—moderately well drained; Tonka—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: Forman—at a depth of more than 6 feet; Cresbard—at a depth of 3.5 to 5.0 feet; Tonka—0.5 foot above to 1.0 foot below the surface
Flooding: None
Ponding: Forman—none; Cresbard—none; Tonka—frequent for long periods
Permeability: Forman—moderately slow; Cresbard—slow; Tonka—slow
Available water capacity: High
Organic matter content: Forman—high; Cresbard—moderate; Tonka—high
Surface runoff: Forman—slow; Cresbard—slow; Tonka—negligible
Other properties: The Cresbard soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Badger soils on toe slopes
• The somewhat poorly drained Hamerly soils, which are calcareous at or near the surface; on foot slopes
• The moderately well drained Cavour soils, which have a sodium-affected subsoil; on foot slopes
• The well drained Ethan soils, which are calcareous at or near the surface; on shoulder slopes

Similar inclusions:
• Soils that have less clay in the subsoil than the Forman soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Forman and Cresbard—alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat; Tonka—barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Forman—conserving moisture; Cresbard—a slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration; Tonka—wetness
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.
• Delaying tillage when the Tonka soil is wet helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water on the Tonka soil.

Interpretive Groups

Land capability classification: Forman—IIc-2; Cresbard—IIIs-1; Tonka—IVw-1
Range site: Forman—Silty; Cresbard—Clayey; Tonka—Wet Meadow
Windbreak suitability group: Forman—3; Cresbard—4; Tonka—10
Pasture suitability group: Forman—F; Cresbard—E; Tonka—B2

HaA—Hamerly loam, 0 to 2 percent slopes

Composition

Hamerly and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Foot slopes
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 5 to 30 acres

Typical Profile

Surface layer:
0 to 6 inches—very dark gray, calcareous loam
Subsurface layer:
6 to 10 inches—very dark gray, calcareous loam
Subsoil:
10 to 20 inches—light brownish gray, calcareous loam
20 to 27 inches—light gray, mottled, calcareous loam
Underlying layer:
27 to 60 inches—pale yellow, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 1.5 to 3.5 feet
Flooding: None
Ponding: None
Permeability: Moderately slow

Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The moderately well drained Aastad soils, which are calcareous at a greater depth than the Hamerly soil and are dark to a depth of more than 16 inches; on foot slopes
• The very poorly drained Parnell soils in basins
• The poorly drained Vallers soils on toe slopes

Similar inclusions:
• Soils that have more silt and less sand

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Wind erosion and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: IIs-4
Range site: Limy Subirrigated
Windbreak suitability group: 1
Pasture suitability group: A

Hb—Hamerly-Tonka complex

Composition

Hamerly and similar soils: 50 to 65 percent
Tonka and similar soils: 20 to 30 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Till plains
Position on the landform: Hamerly—foot slopes; Tonka—basins
Slope range: Hamerly—0 to 3 percent; Tonka—0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 80 acres

Typical Profile

Hamerly

Surface layer:
0 to 6 inches—very dark gray, calcareous loam
Subsurface layer:
6 to 10 inches—very dark gray, calcareous loam
Subsoil:
10 to 20 inches—light brownish gray, calcareous loam
20 to 27 inches—light gray, mottled, calcareous loam
Underlying layer:
27 to 60 inches—pale yellow, mottled, calcareous loam

Tonka

Surface layer:
0 to 14 inches—dark gray silty clay loam
Subsurface layer:
14 to 24 inches—gray, mottled silt loam
Subsoil:
24 to 46 inches—dark gray, mottled silty clay loam
46 to 53 inches—grayish brown, mottled silty clay loam
Underlying layer:
53 to 60 inches—light brownish gray, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Hamerly—somewhat poorly drained; Tonka—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: Hamerly—at a depth of 1.5 to 3.5 feet; Tonka—0.5 foot above to 1.0 foot below the surface
Flooding: None
Ponding: Hamerly—none; Tonka—frequent for long periods
Permeability: Hamerly—moderately slow; Tonka—slow
Available water capacity: High
Organic matter content: High
Surface runoff: Hamerly—slow; Tonka—negligible
Other properties: The Hamerly soil has a high content of lime.

Inclusions

Contrasting inclusions:
• Aastad soils, which are calcareous at a greater depth than the Hamerly soil; on foot slopes
• The well drained Barnes and Forman soils on summits and back slopes
• The very poorly drained Parnell soils in the deeper basins
• The poorly drained Vallers soils on toe slopes

Similar inclusions:
• Soils that have a gray surface layer; in areas where the original surface layer has been mixed with the subsurface layer or the subsoil by cultivation
• Soils that have more silt and less sand than the Hamerly soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Hamerly—alfalfa, barley, corn, oats, soybeans, and spring wheat; Tonka—barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Hamerly—wind erosion and the high content of lime, which adversely affects the availability of plant nutrients; Tonka—wetness
Management measures:
• In wet years these soils are better suited to late planted crops than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Delaying fieldwork when the Tonka soil is wet helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: Hamerly—IIs-4; Tonka—IVw-2
Range site: Hamerly—Limy Subirrigated; Tonka—Wet Meadow
Windbreak suitability group: Hamerly—1; Tonka—10
Pasture suitability group: Hamerly—A; Tonka—B2

Hd—Harriet loam

Composition

Harriet and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 160 acres

Typical Profile

Surface layer:
0 to 4 inches—gray loam
Subsoil:
4 to 10 inches—dark grayish brown clay loam
10 to 17 inches—dark gray, calcareous clay that has masses of salt
17 to 43 inches—light brownish gray and grayish brown, calcareous clay that has gypsum crystals and other salts
Underlying layer:
43 to 50 inches—light olive gray, mottled, calcareous clay loam that has gypsum crystals and other salts
50 to 60 inches—light olive gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: At the surface to 1 foot below the surface
Flooding: Occasional for long periods
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Very slow
Other properties: This soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Ranslo soils, which have a thicker surface layer than the Harriet soil; on the slightly higher parts of low flood plains
• The somewhat poorly drained Lowe soils, which have less clay and more sand in the subsoil than the Harriet soil; on low flood plains
• Playmoor soils, which have less clay and more silt in the subsoil than the Harriet soil; on low flood plains

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: A slow rate of water infiltration, wetness, and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Proper grazing management maintains plant vigor.

• Restricting grazing during wet periods helps to prevent surface compaction.

Interpretive Groups

Land capability classification: VIs-6
Range site: Saline Lowland
Windbreak suitability group: 10
Pasture suitability group: J

He—Heil silt loam

Composition

Heil and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Basins
Slope range: 0 to 1 percent
Shape of areas: Oval
Size of areas: 5 to 20 acres

Typical Profile

Surface layer:
0 to 2 inches—dark gray silt loam

Subsurface layer:
2 to 4 inches—gray silt loam

Subsoil:
4 to 30 inches—dark gray silty clay
30 to 40 inches—gray, mottled clay loam that has gypsum crystals

Underlying layer:
40 to 58 inches—light brownish gray, mottled, calcareous loam that has gypsum masses
58 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: 1.0 foot above to 1.5 feet below the surface
Flooding: None
Ponding: Frequent for long periods
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Negligible
Other properties: This soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The moderately well drained Hamerly soils, which are calcareous at or near the surface; on foot slopes and along the edges of the unit
• The very poorly drained Parnell soils, which do not have a sodium-affected subsoil; in the lower parts of basins

Similar inclusions:
• Soils that have a thicker surface layer
• Soils that have visible salts closer to the surface

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Wetness, a slow rate of water infiltration, and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Proper grazing management maintains plant vigor.
• Restricting grazing during wet periods helps to prevent surface compaction.

Interpretive Groups

Land capability classification: VIs-6
Range site: Closed Depression
Windbreak suitability group: 10
Pasture suitability group: B2

HkB—Henkin-Blendon fine sandy loams, 2 to 6 percent slopes

Composition

Henkin and similar soils: 45 to 55 percent
Blendon and similar soils: 30 to 45 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Outwash plains
Position on the landform: Henkin—summits and back slopes; Blendon—foot slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 15 to 20 acres

Typical Profile

Henkin

Surface layer:
0 to 8 inches—very dark grayish brown fine sandy loam

Subsoil:
8 to 26 inches—brown sandy loam
26 to 38 inches—light yellowish brown, calcareous sandy loam

Underlying layer:
38 to 60 inches—light yellowish brown, calcareous loamy fine sand

Blendon

Surface layer:
0 to 8 inches—very dark grayish brown fine sandy loam

Subsoil:
8 to 22 inches—dark grayish brown sandy loam

Underlying layer:
22 to 42 inches—brown sandy loam
42 to 60 inches—yellowish brown, calcareous loamy fine sand

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Henkin—40 to more than 60 inches over glacial till or gravelly material; Blendon—40 to more than 60 inches over glacial till
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderately rapid
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Medium

Inclusions

Contrasting inclusions:
• The somewhat excessively drained Delmont soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes
• Enet soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• Houdek soils, which have less sand and more clay in the subsoil than the major soils; on back slopes

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Wind erosion, water erosion, moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and maintain the content of organic matter.
• Wind stripcropping and field windbreaks help to control wind erosion.

Interpretive Groups

Land capability classification: Henkin—IIIe-8; Blendon—IIIe-8
Range site: Henkin—Sandy; Blendon—Sandy
Windbreak suitability group: Henkin—5; Blendon—5
Pasture suitability group: Henkin—H; Blendon—H

HmA—Hetland silty clay loam, 0 to 2 percent slopes

Composition

Hetland and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Ice-walled lake plains
Position on the landform: Summits
Slope range: 0 to 2 percent
Shape of areas: Oval
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark gray silty clay loam

Subsoil:
10 to 16 inches—dark gray silty clay
16 to 23 inches—grayish brown silty clay loam
23 to 35 inches—pale brown, calcareous silty clay loam
35 to 43 inches—light brownish gray, calcareous silty clay loam

Underlying layer:
43 to 60 inches—light brownish gray, calcareous silt loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Cubden soils, which are calcareous at or near the surface; on foot slopes
• The well drained Poinsett soils, which have more silt and less clay in the subsoil than the Hetland soil; on back slopes
• The poorly drained Tonka soils in basins
• The moderately well drained Waubay soils, which have less clay in the subsoil than the Hetland soil; on foot slopes

Similar inclusions:
• Soils that have more clay and less silt

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, spring wheat, and winter wheat
Suitability for cropland: Well suited
Limitations: Slight
Management measures:
• Managing crop residue conserves moisture and helps to maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: I-2
Range site: Silty
Windbreak suitability group: 4
Pasture suitability group: F

HmB—Hetland silty clay loam, 2 to 6 percent slopes

Composition

Hetland and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Ice-walled lake plains
Position on the landform: Summits and back slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark gray silty clay loam

Subsoil:
10 to 16 inches—dark gray silty clay
16 to 23 inches—grayish brown silty clay loam
23 to 35 inches—pale brown, calcareous silty clay loam
35 to 43 inches—light brownish gray, calcareous silty clay loam

Underlying layer:
43 to 60 inches—light brownish gray, calcareous silt loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Medium

Inclusions

Contrasting inclusions:
• The well drained Buse soils, which are calcareous at or near the surface; on shoulder slopes
• The somewhat poorly drained Cubden soils, which are calcareous at or near the surface; on foot slopes
• The well drained Poinsett soils, which have more silt and less clay in the subsoil than the Hetland soil; on back slopes
• The moderately well drained Waubay soils, which have more silt and less clay in the subsoil than the Hetland soil; on foot slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more clay and less silt

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, spring wheat, and winter wheat
Suitability for cropland: Well suited
Management concerns: Water erosion, wind erosion
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: IIe-3

Range site: Silty
Windbreak suitability group: 4
Pasture suitability group: F

HnB—Houdek-Ethan-Prosper loams, 1 to 6 percent slopes

Composition

Houdek and similar soils: 30 to 45 percent
Ethan and similar soils: 20 to 30 percent
Prosper and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Houdek—back slopes; Ethan—shoulder slopes; Prosper—foot slopes
Slope range: Houdek—2 to 6 percent; Ethan—2 to 6 percent; Prosper—1 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

Houdek

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 17 inches—dark grayish brown clay loam
17 to 26 inches—light yellowish brown, calcareous clay loam
26 to 42 inches—light yellowish brown, calcareous loam

Underlying layer:
42 to 60 inches—light brownish gray, mottled, calcareous loam that has nests of gypsum

Ethan

Surface layer:
0 to 9 inches—dark grayish brown, calcareous loam

Subsoil:
9 to 30 inches—very pale brown, calcareous loam

Underlying layer:
30 to 45 inches—pale yellow, mottled, calcareous loam
45 to 60 inches—light yellowish brown, mottled, calcareous loam

Prosper

Surface layer:
0 to 9 inches—dark gray loam

Subsurface layer:
9 to 13 inches—dark grayish brown loam

Subsoil:
13 to 27 inches—dark gray clay loam
27 to 32 inches—grayish brown clay loam
32 to 41 inches—light yellowish brown, calcareous loam
41 to 48 inches—light yellowish brown, mottled, calcareous loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Houdek—well drained; Ethan—well drained; Prosper—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Houdek—greater than 6 feet; Ethan—greater than 6 feet; Prosper—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Houdek—moderate; Ethan—moderately low; Prosper—high
Surface runoff: Houdek—medium; Ethan—medium; Prosper—slow
Other properties: The Ethan soil has a high content of lime. Runoff water flows over the Prosper soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• Betts soils, which are dark to a depth of less than 7 inches; on shoulder slopes
• Stickney soils, which have a subsoil that is slightly affected by sodium; on foot slopes
• The poorly drained Tetonka soils in basins

Similar inclusions:
• Soils that have less clay in the subsoil than the Houdek soil
• Soils that have more clay in the subsoil than the Houdek soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Houdek—water erosion; Ethan—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Prosper—conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.

• Contour farming and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular to be farmed on the contour.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Houdek—IIe-2; Ethan—IIIe-12; Prosper—IIc-3
Range site: Houdek—Silty; Ethan—Thin Upland; Prosper—Loamy Overflow
Windbreak suitability group: Houdek—3; Ethan—8; Prosper—1
Pasture suitability group: Houdek—F; Ethan—G; Prosper—K

HnC—Houdek-Ethan-Prosper loams, 2 to 9 percent slopes

Composition

Houdek and similar soils: 40 to 50 percent
Ethan and similar soils: 20 to 35 percent
Prosper and similar soils: 10 to 20 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Houdek—back slopes; Ethan—shoulder slopes; Prosper—foot slopes
Slope range: Houdek—6 to 9 percent; Ethan—6 to 9 percent; Prosper—2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 40 acres

Typical Profile

Houdek

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 17 inches—dark grayish brown clay loam
17 to 26 inches—light yellowish brown, calcareous clay loam
26 to 42 inches—light yellowish brown, calcareous loam

Underlying layer:
42 to 60 inches—light brownish gray, mottled, calcareous loam that has nests of gypsum

Ethan

Surface layer:
0 to 9 inches—dark grayish brown, calcareous loam

Subsoil:
9 to 30 inches—very pale brown, calcareous loam

Underlying layer:
30 to 45 inches—pale yellow, mottled, calcareous loam
45 to 60 inches—light yellowish brown, mottled, calcareous loam

Prosper

Surface layer:
0 to 9 inches—dark gray loam

Subsurface layer:
9 to 13 inches—dark grayish brown loam

Subsoil:
13 to 27 inches—dark gray clay loam
27 to 32 inches—grayish brown clay loam
32 to 41 inches—light yellowish brown, calcareous loam
41 to 48 inches—light yellowish brown, mottled, calcareous loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Houdek—well drained; Ethan—well drained; Prosper—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Houdek—greater than 6 feet; Ethan—greater than 6 feet; Prosper—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Houdek—moderate; Ethan—moderately low; Prosper—high
Surface runoff: Medium
Other properties: The Ethan soil has a high content of lime. Runoff water flows over the Prosper soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• Betts soils, which are dark to a depth of less than 7 inches; on shoulder slopes
• Stickney soils, which have a subsoil that is slightly affected by sodium; on foot slopes
• The poorly drained Tetonka soils in basins

Similar inclusions:
• Soils that have less clay in the subsoil than the Houdek soil
• Soils that have more clay in the subsoil than the Houdek soil

Use and Management

Dominant land use: Cropland

Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, spring wheat, and sunflowers
Suitability for cropland: Fairly well suited
Management concerns: Houdek—water erosion; Ethan—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Prosper—water erosion
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming, terraces, and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular for terraces or for contour farming.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Houdek—IIIe-2; Ethan—IVe-3; Prosper—IIe-3
Range site: Houdek—Silty; Ethan—Thin Upland; Prosper—Silty
Windbreak suitability group: Houdek—3; Ethan—8; Prosper—1
Pasture suitability group: Houdek—F; Ethan—G; Prosper—K

HpA—Houdek-Prosper loams, 0 to 2 percent slopes

Composition

Houdek and similar soils: 60 to 70 percent
Prosper and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Houdek—summits and back slopes; Prosper—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Houdek

Surface layer:
0 to 8 inches—dark gray loam
Subsoil:
8 to 17 inches—dark grayish brown clay loam
17 to 26 inches—light yellowish brown, calcareous clay loam
26 to 42 inches—light yellowish brown, calcareous loam
Underlying layer:
42 to 60 inches—light brownish gray, mottled, calcareous loam that has nests of gypsum

Prosper

Surface layer:
0 to 9 inches—dark gray loam
Subsurface layer:
9 to 13 inches—dark grayish brown loam
Subsoil:
13 to 27 inches—dark gray clay loam
27 to 32 inches—grayish brown clay loam
32 to 41 inches—light yellowish brown, calcareous loam
41 to 48 inches—light yellowish brown, mottled, calcareous loam
Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Houdek—well drained; Prosper—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Houdek—greater than 6 feet; Prosper—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Houdek—moderate; Prosper—high
Surface runoff: Slow
Other properties: Runoff water flows over the Prosper soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• Stickney soils, which have a subsoil that is slightly affected by sodium; on foot slopes
• The poorly drained Tetonka soils in basins

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited

Management concerns: Conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface conserve moisture.

Interpretive Groups

Land capability classification: Houdek—IIc-2; Prosper—IIc-3
Range site: Houdek—Silty; Prosper—Loamy Overflow
Windbreak suitability group: Houdek—3; Prosper—1
Pasture suitability group: Houdek—F; Prosper—K

HpB—Houdek-Prosper loams, 1 to 6 percent slopes

Composition

Houdek and similar soils: 60 to 70 percent
Prosper and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Houdek—summits and back slopes; Prosper—foot slopes
Slope range: Houdek—2 to 6 percent; Prosper—1 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 150 acres

Typical Profile

Houdek

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 17 inches—dark grayish brown clay loam
17 to 26 inches—light yellowish brown, calcareous clay loam
26 to 42 inches—light yellowish brown, calcareous loam

Underlying layer:
42 to 60 inches—light brownish gray, mottled, calcareous loam that has nests of gypsum

Prosper

Surface layer:
0 to 9 inches—dark gray loam

Subsurface layer:
9 to 13 inches—dark grayish brown loam

Subsoil:
13 to 27 inches—dark gray clay loam
27 to 32 inches—grayish brown clay loam
32 to 41 inches—light yellowish brown, calcareous loam
41 to 48 inches—light yellowish brown, mottled, calcareous loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Houdek—well drained; Prosper—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Houdek—greater than 6 feet; Prosper—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Houdek—moderate; Prosper—high
Surface runoff: Houdek—medium; Prosper—slow
Other properties: Runoff water flows over the Prosper soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The well drained Ethan soils, which are calcareous at or near the surface; on shoulder slopes
• Stickney soils, which have a subsoil that is slightly affected by sodium; on foot slopes
• The poorly drained Tetonka soils in basins

Similar inclusions:
• Soils that have less clay in the subsoil than the Houdek soil
• Soils that have more clay in the subsoil than the Houdek soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Houdek—water erosion; Prosper—conserving moisture
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in most areas are too short or too irregular to be farmed on the contour.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Houdek—IIe-2; Prosper—IIc-3
Range site: Houdek—Silty; Prosper—Loamy Overflow
Windbreak suitability group: Houdek—3; Prosper—1
Pasture suitability group: Houdek—F; Prosper—K

HsA—Houdek-Stickney complex, 0 to 2 percent slopes

Composition

Houdek and similar soils: 55 to 65 percent
Stickney and similar soils: 20 to 35 percent
Contrasting inclusions: 5 to 25 percent

Setting

Landform: Till plains
Position on the landform: Houdek—summits and back slopes; Stickney—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 300 acres

Typical Profile

Houdek

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 17 inches—dark grayish brown clay loam
17 to 26 inches—light yellowish brown, calcareous clay loam
26 to 42 inches—light yellowish brown, calcareous loam

Underlying layer:
42 to 60 inches—light brownish gray, mottled, calcareous loam that has nests of gypsum

Stickney

Surface layer:
0 to 6 inches—dark gray silt loam

Subsurface layer:
6 to 9 inches—gray silt loam

Transitional layer:
9 to 11 inches—dark gray and gray silty clay loam

Subsoil:
11 to 20 inches—dark gray silty clay loam
20 to 30 inches—very dark gray silty clay
30 to 34 inches—pale yellow, mottled, calcareous clay loam that has masses of salt
34 to 40 inches—light yellowish brown, mottled, calcareous clay loam

Underlying layer:
40 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Houdek—well drained; Stickney—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Houdek—greater than 6 feet; Stickney—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Houdek—moderately slow; Stickney—slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Other properties: The Stickney soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• Dudley soils, which have a subsoil that is more adversely affected by sodium than that of the Stickney soil; on foot slopes
• The poorly drained Tetonka soils in basins
• The somewhat poorly drained Crossplain soils, which do not have a sodium-affected subsoil; on toe slopes

Similar inclusions:
• Soils that have more clay in the subsoil than the Houdek soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Houdek—conserving moisture; Stickney—a slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soils are dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Houdek—IIc-2; Stickney—IIIs-1
Range site: Houdek—Silty; Stickney—Clayey

Windbreak suitability group: Houdek—3; Stickney—4
Pasture suitability group: Houdek—F; Stickney—E

HsB—Houdek-Stickney complex, 2 to 6 percent slopes

Composition

Houdek and similar soils: 55 to 65 percent
Stickney and similar soils: 20 to 35 percent
Contrasting inclusions: 5 to 25 percent

Setting

Landform: Till plains
Position on the landform: Houdek—summits and back slopes; Stickney—foot slopes
Slope range: Houdek—2 to 6 percent; Stickney—2 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Houdek

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 17 inches—dark grayish brown clay loam
17 to 26 inches—light yellowish brown, calcareous clay loam
26 to 42 inches—light yellowish brown, calcareous loam

Underlying layer:
42 to 60 inches—light brownish gray, mottled, calcareous loam that has nests of gypsum

Stickney

Surface layer:
0 to 6 inches—dark gray silt loam

Subsurface layer:
6 to 9 inches—gray silt loam

Transitional layer:
9 to 11 inches—dark gray and gray silty clay loam

Subsoil:
11 to 20 inches—dark gray silty clay loam
20 to 30 inches—very dark gray silty clay
30 to 34 inches—pale yellow, mottled, calcareous clay loam that has masses of salt
34 to 40 inches—light yellowish brown, mottled, calcareous clay loam

Underlying layer:
40 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Houdek—well drained; Stickney—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Houdek—greater than 6 feet; Stickney—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Houdek—moderately slow; Stickney—slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Medium
Other properties: The Stickney soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The moderately well drained Prosper soils, which do not have a sodium-affected subsoil; on foot slopes
• The well drained Ethan soils, which are calcareous at or near the surface; on shoulder slopes
• Dudley soils, which have a subsoil that is more adversely affected by sodium than that of the Stickney soil; on foot slopes
• The poorly drained Tetonka soils in basins

Similar inclusions:
• Soils that have less clay in the subsoil than the Houdek soil
• Soils that have more clay in the subsoil than the Houdek soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Houdek—water erosion; Stickney—a slow rate of water infiltration, water erosion, and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soils are dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Houdek—IIe-2; Stickney—IIIe-15
Range site: Houdek—Silty; Stickney—Clayey
Windbreak suitability group: Houdek—3; Stickney—4
Pasture suitability group: Houdek—F; Stickney—E

Ht—Houdek-Stickney-Tetonka complex

Composition

Houdek and similar soils: 40 to 55 percent
Stickney and similar soils: 20 to 30 percent
Tetonka and similar soils: 10 to 20 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Houdek—summits and back slopes; Stickney—foot slopes; Tetonka—basins
Slope range: Houdek—0 to 2 percent; Stickney—0 to 2 percent; Tetonka—0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 600 acres

Typical Profile

Houdek

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 17 inches—dark grayish brown clay loam
17 to 26 inches—light yellowish brown, calcareous clay loam
26 to 42 inches—light yellowish brown, calcareous loam

Underlying layer:
42 to 60 inches—light brownish gray, mottled, calcareous loam that has nests of gypsum

Stickney

Surface layer:
0 to 6 inches—dark gray silt loam

Subsurface layer:
6 to 9 inches—gray silt loam

Transitional layer:
9 to 11 inches—dark gray and gray silty clay loam

Subsoil:
11 to 20 inches—dark gray silty clay loam
20 to 30 inches—very dark gray silty clay
30 to 34 inches—pale yellow, mottled, calcareous clay loam that has masses of salt
34 to 40 inches—light yellowish brown, mottled, calcareous clay loam

Underlying layer:
40 to 60 inches—light brownish gray, mottled, calcareous clay loam

Tetonka

Surface layer:
0 to 7 inches—gray silt loam

Subsurface layer:
7 to 12 inches—gray, mottled silt loam

Subsoil:
12 to 33 inches—dark gray silty clay
33 to 44 inches—light brownish gray, mottled, calcareous clay loam

Underlying layer:
44 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Houdek—well drained; Stickney—moderately well drained; Tetonka—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: Houdek—at a depth of more than 6 feet; Stickney—at a depth of 3.5 to 5.0 feet; Tetonka—1 foot above to 1 foot below the surface
Flooding: None
Ponding: Houdek—none; Stickney—none; Tetonka—frequent for long periods
Permeability: Houdek—moderately slow; Stickney—slow; Tetonka—slow
Available water capacity: High
Organic matter content: Houdek—moderate; Stickney—moderate; Tetonka—high
Surface runoff: Houdek—slow; Stickney—slow; Tetonka—negligible
Other properties: The Stickney soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Crossplain soils on toe slopes
• The moderately well drained Davison soils, which are calcareous at or near the surface; on foot slopes
• Dudley soils, which have a subsoil that is more adversely affected by sodium than that of the Stickney soil; on foot slopes
• The well drained Ethan soils, which are calcareous at or near the surface; on shoulder slopes

Similar inclusions:
• Soils that have less clay in the subsoil than the Houdek soil

Use and Management

Dominant land use: Cropland

Other land use: Pasture and hayland

Cropland

Main crops: Houdek and Stickney—alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat; Tetonka—barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Houdek—conserving moisture; Stickney—a slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration; Tetonka—wetness, surface compaction if tilled when wet
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.
• Delaying tillage when the Tetonka soil is wet helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water on the Tetonka soil.

Interpretive Groups

Land capability classification: Houdek—IIc-2; Stickney—IIIs-1; Tetonka—IVw-1
Range site: Houdek—Silty; Stickney—Clayey; Tetonka—Wet Meadow
Windbreak suitability group: Houdek—3; Stickney—4; Tetonka—10
Pasture suitability group: Houdek—F; Stickney—E; Tetonka—B2

Hv—Hoven silt loam

Composition

Hoven and similar soils: 85 to 99 percent
Contrasting inclusions: 1 to 15 percent

Setting

Landform: Till plains
Position on the landform: Basins
Slope range: 0 to 1 percent
Shape of areas: Oval
Size of areas: 5 to 20 acres

Typical Profile

Surface layer:
0 to 2 inches—gray silt loam
Subsoil:
2 to 10 inches—dark gray and gray silty clay
10 to 33 inches—dark gray silty clay that has masses of salt
33 to 40 inches—light gray, mottled, calcareous silty clay loam that has masses of salt
40 to 50 inches—gray, mottled, calcareous silty clay that has masses of gypsum and other salts
Underlying layer:
50 to 60 inches—light olive gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 1.0 foot above to 1.5 feet below the surface
Flooding: None
Ponding: Frequent for long periods
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Negligible
Other properties: This soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• Tetonka soils, which have a thicker surface layer than the Hoven soil and do not have a sodium-affected subsoil; in the deeper basins

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: The sodium-affected subsoil, which adversely affects plant growth by restricting root penetration; a slow rate of water infiltration; wetness; and surface compaction if tilled or grazed when wet
Management measures:
• Proper grazing management maintains plant vigor.
• Restricting grazing during wet periods helps to prevent surface compaction.

Interpretive Groups

Land capability classification: VIs-6
Range site: Closed Depression
Windbreak suitability group: 10
Pasture suitability group: B2

KrB—Kranzburg-Buse-Waubay complex, 1 to 6 percent slopes

Composition

Kranzburg and similar soils: 30 to 45 percent
Buse and similar soils: 20 to 30 percent
Waubay and similar soils: 20 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Kranzburg—summits and back slopes; Buse—shoulder slopes; Waubay—foot slopes
Slope range: Kranzburg—2 to 6 percent; Buse—3 to 6 percent; Waubay—1 to 2 percent
Shape of areas: Irregular
Size of areas: 40 to 300 acres

Typical Profile

Kranzburg

Surface layer:
0 to 7 inches—dark gray silt loam

Subsoil:
7 to 20 inches—grayish brown and brown silt loam
20 to 30 inches—light gray, calcareous silt loam
30 to 37 inches—light gray, mottled, calcareous loam

Underlying layer:
37 to 60 inches—pale yellow, mottled, calcareous clay loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Waubay

Surface soil:
0 to 12 inches—very dark gray silty clay loam

Subsoil:
12 to 17 inches—dark gray silty clay loam
17 to 23 inches—brown silty clay loam
23 to 39 inches—light yellowish brown, calcareous silt loam

Underlying layer:
39 to 60 inches—light gray and grayish brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Kranzburg—well drained; Buse—well drained; Waubay—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Kranzburg—20 to 40 inches over loamy glacial till; Buse—greater than 60 inches; Waubay—40 to more than 60 inches over loamy glacial till
Depth to the water table: Kranzburg—greater than 6 feet; Buse—greater than 6 feet; Waubay—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Kranzburg—moderately slow; Buse—moderately slow; Waubay—moderate
Available water capacity: High
Organic matter content: Kranzburg—high; Buse—moderately low; Waubay—high
Surface runoff: Kranzburg—medium; Buse—medium; Waubay—slow
Other properties: The Buse soil has a high content of lime. Runoff water flows over the Waubay soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Cubden soils, which are calcareous at or near the surface; on foot slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more sand and less silt in the subsoil than the Kranzburg soil
• Soils that have more silt and less sand in the underlying material than the Buse soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Kranzburg—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Waubay—only slight limitations
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular to be farmed on the contour.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to

control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Kranzburg—IIe-3; Buse—IIIe-6; Waubay—I-3
Range site: Kranzburg—Silty; Buse—Thin Upland; Waubay—Loamy Overflow
Windbreak suitability group: Kranzburg—3; Buse—8; Waubay—1
Pasture suitability group: Kranzburg—F; Buse—G; Waubay—K

La—La Prairie loam

Composition

La Prairie and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Position on the landform: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 8 inches—dark gray loam

Subsurface layer:
8 to 18 inches—dark gray, calcareous loam

Subsoil:
18 to 30 inches—gray and grayish brown, calcareous loam
30 to 50 inches—light brownish gray, calcareous silt loam
50 to 60 inches—gray and grayish brown, calcareous silt loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over clayey or sandy material
Depth to the water table: 3.5 to 5.0 feet
Flooding: Rare
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The poorly drained Ranslo soils, which have a sodium-affected subsoil; on low flood plains
• The poorly drained Holmquist soils, which are stratified; on low flood plains
• The somewhat poorly drained Moritz soils, which are calcareous at or near the surface and have less sand and more silt than the La Prairie soil; on low flood plains
• The poorly drained Playmoor soils, which have salts at or near the surface; on low flood plains

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Conserving moisture
Management measures:
• Managing crop residue conserves moisture and helps to maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: IIc-1
Range site: Silty
Windbreak suitability group: 1
Pasture suitability group: K

Lf—La Prairie-Fairdale loams, channeled

Composition

La Prairie and similar soils: 60 to 70 percent
Fairdale and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Position on the landform: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 40 to 300 acres

Typical Profile

La Prairie

Surface layer:
0 to 8 inches—dark gray loam

Subsurface layer:
8 to 18 inches—dark gray, calcareous loam

Subsoil:
18 to 30 inches—gray and grayish brown, calcareous loam
30 to 50 inches—light brownish gray, calcareous silt loam
50 to 60 inches—gray and grayish brown, calcareous silt loam

Fairdale

Surface layer:
0 to 8 inches—dark gray, calcareous loam

Underlying layer:
8 to 45 inches—gray and dark gray, calcareous sandy loam and loam; stratified with thin lenses of fine sand in the upper part, mottled in the lower part
45 to 60 inches—light gray, calcareous sand

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: La Prairie—40 to more than 60 inches over clayey or sandy material; Fairdale—40 to more than 60 inches over sandy material
Depth to the water table: La Prairie—3.5 to 5.0 feet; Fairdale—3.0 to 5.0 feet
Flooding: La Prairie—occasional for brief periods; Fairdale—frequent for brief periods
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: These soils typically are dissected by meandering stream channels.

Inclusions

Contrasting inclusions:
• The well drained Barnes soils, which formed in clay loam glacial till; on back slopes near the edges of the unit
• Embden soils, which have more sand and less clay than the La Prairie soil; on foot slopes
• Spottswood soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The poorly drained Lowe soils, which are calcareous at or near the surface; on low flood plains

Similar inclusions:
• Soils that have more silt and less sand throughout than the La Prairie soil
• Soils that have visible salts above a depth of 40 inches

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Wetness and the meandering channels, which limit cultivation
Management measures:
• Proper grazing management maintains plant vigor.

Interpretive Groups

Land capability classification: La Prairie—VIw-1; Fairdale—VIw-1
Range site: La Prairie—Loamy Overflow; Fairdale—Loamy Overflow
Windbreak suitability group: La Prairie—1; Fairdale—1
Pasture suitability group: La Prairie—NS; Fairdale—NS

Lh—La Prairie-Holmquist loams, channeled

Composition

La Prairie and similar soils: 55 to 60 percent
Holmquist and similar soils: 20 to 30 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Flood plains
Position on the landform: La Prairie—high flood plains; Holmquist—low flood plains
Slope range: La Prairie—0 to 2 percent; Holmquist—0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 80 acres

Typical Profile

La Prairie

Surface layer:
0 to 8 inches—dark gray loam

Subsurface layer:
8 to 18 inches—dark gray, calcareous loam

Subsoil:
18 to 30 inches—gray and grayish brown, calcareous loam
30 to 50 inches—light brownish gray, calcareous silt loam
50 to 60 inches—gray and grayish brown, calcareous silt loam

Holmquist

Surface layer:
0 to 10 inches—dark gray, calcareous loam stratified with thin layers of fine sandy loam

Underlying layer:
10 to 45 inches—gray and grayish brown, calcareous loam; thin layers of fine sandy loam that has

masses of salt in the upper part and thin layers of sandy loam in the lower part; mottled below a depth of 26 inches
45 to 60 inches—gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: La Prairie—moderately well drained; Holmquist—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: La Prairie—40 to more than 60 inches over clayey or sandy material; Holmquist—greater than 60 inches
Depth to the water table: La Prairie—3.5 to 5.0 feet; Holmquist—0.5 foot to 1.5 feet
Flooding: La Prairie—occasional for brief periods; Holmquist—frequent for brief periods
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: La Prairie—high; Holmquist—moderate
Surface runoff: La Prairie—slow; Holmquist—very slow
Other properties: These soils typically are dissected by meandering stream channels.

Inclusions

Contrasting inclusions:
• The well drained Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on back slopes
• The well drained Forman soils, which formed in loamy glacial till; on back slopes
• The excessively drained Sioux soils, which have gravelly material within a depth of 14 inches; on shoulder slopes
• The very poorly drained Rauville soils, which have less sand and more silt than the major soils; on low flood plains

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Wetness and the meandering channels, which limit cultivation
Management measures:
• Proper grazing management maintains plant vigor.
• Restricting grazing during wet periods helps to prevent surface compaction.

Interpretive Groups

Land capability classification: La Prairie—VIw-1; Holmquist—VIw-1
Range site: La Prairie—Loamy Overflow; Holmquist—Saline Subirrigated
Windbreak suitability group: La Prairie—1; Holmquist—10
Pasture suitability group: La Prairie—NS; Holmquist—NS

Lk—LaDelle silt loam

Composition

LaDelle and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Position on the landform: High flood plains
Slope range: 0 to 2 percent
Shape of areas: Long and narrow
Size of areas: 5 to 100 acres

Typical Profile

Surface soil:
0 to 19 inches—very dark gray silt loam
Subsoil:
19 to 27 inches—grayish brown, calcareous silt loam
27 to 40 inches—dark gray, calcareous silty clay loam
Underlying layer:
40 to 60 inches—dark grayish brown, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 3.5 to 5.0 feet
Flooding: Rare
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The poorly drained, saline Playmoor soils on low flood plains
• The somewhat poorly drained Moritz soils, which are calcareous at or near the surface; on low flood plains
• Embden soils, which formed in loamy sediments; on foot slopes
• The stratified Fairdale soils, which are dark to a depth of less than 17 inches; adjacent to stream channels
Similar inclusions:
• Soils that have more sand and less silt

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Conserving moisture
Management measures:
• Managing crop residue conserves moisture and helps to maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: IIc-1
Range site: Silty
Windbreak suitability group: 1
Pasture suitability group: K

Lm—Lamo silty clay loam

Composition

Lamo and similar soils: 75 to 90 percent
Contrasting inclusions: 10 to 25 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

Surface layer:
0 to 5 inches—very dark gray silty clay loam
Subsurface layer:
5 to 24 inches—very dark gray and dark gray, calcareous silty clay loam
Transitional layer:
24 to 32 inches—gray, calcareous silty clay loam
Subsoil:
32 to 37 inches—gray, calcareous silt loam
Underlying layer:
37 to 52 inches—light gray, calcareous silt loam
52 to 60 inches—light gray, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 1 to 3 feet
Flooding: Occasional for brief periods
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The poorly drained Salmo soils, which have salts at or near the surface; in positions on the landscape similar to or slightly lower than those of the Lamo soil
• Delmont soils, which have gravelly material at a depth of 20 to 40 inches; on back slopes
• Farmsworth soils, which have a sodium-affected subsoil; on high flood plains

Similar inclusions:
• Soils that are more calcareous in the subsoil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Wetness, wind erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• In wet years this soil is better suited to late planted crops than to other crops.
• Leaving crop residue on the surface and deferring tillage when the soil is wet maintain tilth, help to prevent surface compaction, and help to control erosion.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IIw-2
Range site: Subirrigated
Windbreak suitability group: 2
Pasture suitability group: A

Lo—Lowe loam

Composition

Lowe and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 40 to 200 acres

Typical Profile

Surface layer:
0 to 10 inches—very dark gray, calcareous loam
Subsoil:
10 to 34 inches—gray, calcareous loam
Underlying layer:
34 to 56 inches—light gray, mottled, calcareous silt loam
56 to 60 inches—light gray, mottled, calcareous gravelly loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over gravelly material
Seasonal high water table: At the surface to 1.5 feet below the surface
Flooding: Occasional for brief periods
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Very slow
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Moritz soils on low flood plains
• The somewhat poorly drained Divide soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The poorly drained Marysland soils, which have gravelly material at a depth of 20 to 40 inches; on low flood plains
• The very poorly drained Rauville soils on low flood plains
Similar inclusions:
• Soils that are more calcareous in the subsoil
• Soils that have more silt

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Wetness, wind erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• In wet years this soil is better suited to late planted crops than to other crops.
• Leaving crop residue on the surface and deferring tillage when the soil is wet maintain tilth, help to prevent surface compaction, and help to control erosion.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-3
Range site: Subirrigated
Windbreak suitability group: 10
Pasture suitability group: A

Lw—Ludden silty clay, saline

Composition

Ludden and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 5 to 40 acres

Typical Profile

Surface layer:
0 to 8 inches—dark gray, calcareous silty clay that has masses of salt
Subsoil:
8 to 20 inches—dark gray, calcareous silty clay that has masses of salt
20 to 31 inches—very dark gray, calcareous silty clay loam that has gypsum crystals and other salts
Underlying layer:
31 to 41 inches—gray, mottled, calcareous silty clay that has gypsum crystals
41 to 60 inches—gray, mottled, calcareous clay loam that has gypsum crystals

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: At the surface to 1.5 feet below the surface
Flooding: Frequent for long periods
Ponding: None
Permeability: Slow
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Very slow
Other properties: This soil is saline and has a high content of lime.

Inclusions

Contrasting inclusions:
• Ferney soils, which have a sodium-affected subsoil; on foot slopes
• Ranslo and Harriet soils, which have a sodium-affected subsoil; on low flood plains
• Lowe soils, which are calcareous at or near the surface; on low flood plains

Similar inclusions:
• Soils that have less clay and more silt
• Soils that are very poorly drained

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Barley, corn, spring wheat, and sunflowers
Suitability for cropland: Poorly suited
Management concerns: Wetness, wind erosion, a slow rate of water infiltration, tilth, the high salt content, and the risk of compaction if tilled when wet
Management measures:
• In most years this soil is better suited to late planted crops than to other crops.
• Deferring tillage when the soil is wet helps to prevent surface compaction.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-5
Range site: Saline Lowland
Windbreak suitability group: 10
Pasture suitability group: J

MaB—Maddock-Egeland sandy loams, 2 to 6 percent slopes

Composition

Maddock and similar soils: 50 to 60 percent
Egeland and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Maddock—shoulder slopes; Egeland—back slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 40 acres

Typical Profile

Maddock

Surface layer:
0 to 8 inches—dark gray sandy loam

Subsoil:
8 to 16 inches—brown loamy fine sand
16 to 24 inches—light brownish gray, calcareous loamy fine sand

Underlying layer:
24 to 42 inches—light gray, calcareous loamy fine sand
42 to 60 inches—light brownish gray, calcareous loamy fine sand

Egeland

Surface layer:
0 to 8 inches—very dark gray sandy loam

Subsoil:
8 to 15 inches—dark grayish brown fine sandy loam
15 to 21 inches—brown sandy loam
21 to 29 inches—very pale brown, calcareous fine sandy loam

Underlying layer:
29 to 48 inches—pale brown, mottled, calcareous fine sandy loam
48 to 60 inches—light yellowish brown, mottled, calcareous loamy fine sand

Soil Properties and Qualities

Drainage class: Maddock—somewhat excessively drained; Egeland—well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Maddock—40 to more than 60 inches over loamy material; Egeland—40 to more than 60 inches over glacial till
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None

Permeability: Maddock—rapid; Egeland—moderately rapid
Available water capacity: Maddock—low; Egeland—moderate
Organic matter content: Maddock—moderately low; Egeland—moderate
Surface runoff: Maddock—very slow; Egeland—medium

Inclusions

Contrasting inclusions:
• The well drained Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on back slopes
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes

Similar inclusions:
• Soils that are dark to a depth of more than 16 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Maddock—wind erosion, water erosion, moderately low available water capacity; Egeland—wind erosion, water erosion, moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface help to control erosion, conserve moisture, and maintain the content of organic matter.
• Wind stripcropping and field windbreaks help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Maddock—IIIe-7; Egeland—IIIe-7
Range site: Maddock—Sandy; Egeland—Sandy
Windbreak suitability group: Maddock—5; Egeland—5
Pasture suitability group: Maddock—H; Egeland—H

MaC—Maddock-Egeland sandy loams, 6 to 9 percent slopes

Composition

Maddock and similar soils: 50 to 65 percent
Egeland and similar soils: 25 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Maddock—shoulder slopes; Egeland—back slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Maddock

Surface layer:
0 to 8 inches—dark gray sandy loam

Subsoil:
8 to 16 inches—brown loamy fine sand
16 to 24 inches—light brownish gray, calcareous loamy fine sand

Underlying layer:
24 to 42 inches—light gray, calcareous loamy fine sand
42 to 60 inches—light brownish gray, calcareous loamy fine sand

Egeland

Surface layer:
0 to 8 inches—very dark gray sandy loam

Subsoil:
8 to 15 inches—dark grayish brown fine sandy loam
15 to 21 inches—brown sandy loam
21 to 29 inches—very pale brown, calcareous fine sandy loam

Underlying layer:
29 to 48 inches—pale brown, mottled, calcareous fine sandy loam
48 to 60 inches—light yellowish brown, mottled, calcareous loamy fine sand

Soil Properties and Qualities

Drainage class: Maddock—somewhat excessively drained; Egeland—well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Maddock—40 to more than 60 inches over loamy material; Egeland—40 to more than 60 inches over glacial till
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Maddock—rapid; Egeland—moderately rapid
Available water capacity: Maddock—low; Egeland—moderate
Organic matter content: Maddock—moderately low; Egeland—moderate
Surface runoff: Maddock—slow; Egeland—medium

Inclusions

Contrasting inclusions:
• Rusklyn soils, which are calcareous at or near the surface; on shoulder slopes
• Barnes soils, which formed in clay loam glacial till; on back slopes along the edges of the unit
• Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; on back slopes

Similar inclusions:
• Soils that have more clay and less sand throughout
• Soils that have more gravelly material throughout
• Soils that have clay loam glacial till within a depth of 40 to 60 inches

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, barley, oats, and spring wheat
Suitability for cropland: Poorly suited
Management concerns: Maddock—wind erosion, water erosion, moderately low available water capacity; Egeland—wind erosion, water erosion, moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface help to control erosion, conserve moisture, and maintain the content of organic matter.
• Wind stripcropping and field windbreaks help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Maddock—IVe-3; Egeland—IVe-3
Range site: Maddock—Sandy; Egeland—Sandy
Windbreak suitability group: Maddock—5; Egeland—5
Pasture suitability group: Maddock—H; Egeland—H

Md—Marysland-Divide loams

Composition

Marysland and similar soils: 50 to 60 percent
Divide and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains and outwash plains
Position on the landform: Marysland—low flood plains; Divide—foot slopes
Slope range: Marysland—0 to 1 percent; Divide—0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Marysland

Surface layer:
0 to 7 inches—dark gray, calcareous loam
Subsurface layer:
7 to 11 inches—gray, calcareous loam
Subsoil:
11 to 28 inches—gray, mottled, calcareous loam
Underlying layer:
28 to 42 inches—light gray, mottled, calcareous very gravelly sand and gravelly sand
42 to 60 inches—grayish brown, mottled, calcareous very gravelly sand

Divide

Surface layer:
0 to 10 inches—very dark gray, calcareous loam
Subsoil:
10 to 21 inches—light gray, calcareous loam
21 to 28 inches—white, mottled, calcareous loam
28 to 37 inches—light gray, mottled, calcareous loam
Underlying layer:
37 to 60 inches—light gray, mottled, calcareous extremely gravelly loamy sand

Soil Properties and Qualities

Drainage class: Marysland—poorly drained; Divide—somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 20 to 40 inches over gravelly material
Depth to the water table: Marysland—0.5 foot to 1.5 feet; Divide—1.5 to 3.5 feet
Flooding: Marysland—occasional for brief periods; Divide—none
Ponding: None
Permeability: Marysland—moderate in the loamy sediments and rapid in the underlying gravelly material; Divide—moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Moderate
Organic matter content: Marysland—high; Divide—moderate
Surface runoff: Marysland—very slow; Divide—slow
Other properties: Both soils have a high content of lime.

Inclusions

Contrasting inclusions:
• The well drained Fordville soils, which are not calcareous at or near the surface; on back slopes
• The somewhat poorly drained Hamerly soils, which do not have gravelly material within a depth of 40 inches; on foot slopes
• The poorly drained Oldham soils, which do not have gravelly material within a depth of 40 inches; in basins
• The poorly drained Vallers soils, which do not have gravelly material within a depth of 40 inches; on toe slopes

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Barley, oats, and spring wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness, wind erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• In most years these soils are better suited to late planted crops than to other crops.
• Leaving crop residue on the surface and deferring tillage when the soil is wet maintain tilth and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: Marysland—IVw-3; Divide—IIIs-4
Range site: Marysland—Subirrigated; Divide—Limy Subirrigated
Windbreak suitability group: Marysland—10; Divide—1
Pasture suitability group: Marysland—B1; Divide—D1

MsA—Mauvais clay loam, 0 to 2 percent slopes

Composition

Mauvais and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Wave-cut platforms
Position on the landform: Toe slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 120 acres

Typical Profile

Surface layer:
0 to 6 inches—gray, calcareous clay loam
Underlying layer:
6 to 36 inches—light gray, mottled, calcareous clay loam
36 to 60 inches—gray and light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 1.0 to 3.5 feet
Flooding: None
Ponding: Rare for long or very long periods
Permeability: Moderately slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Other properties: This soil has a high content of lime. Ponding occurs in a cyclic pattern. The soil may be ponded continuously for several years and then not ponded for many years.

Inclusions

Contrasting inclusions:
• Minnewasta soils, which are sandy on the surface; on toe slopes slightly higher on the landscape than the Mauvais soil
• The very poorly drained Oldham and Southam soils in basins

Similar inclusions:
• Soils that are more calcareous in the surface layer and subsoil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Wetness, wind erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• In wet years this soil is better suited to late planted crops than to other crops.
• Leaving crop residue on the surface and deferring tillage when the soil is wet maintain tilth, help to prevent

surface compaction, and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-3
Range site: Subirrigated
Windbreak suitability group: 10
Pasture suitability group: A

MtA—Minnewasta sandy loam, 0 to 2 percent slopes

Composition

Minnewasta and similar soils: 75 to 95 percent
Contrasting inclusions: 5 to 25 percent

Setting

Landform: Beach terraces
Position on the landform: Toe slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—very dark gray, calcareous sandy loam

Underlying layer:
6 to 12 inches—light gray, mottled, calcareous sand
12 to 60 inches—light brownish gray and light gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 10 to 20 inches over glacial till
Seasonal high water table: At the surface to 3.5 feet below the surface
Flooding: None
Ponding: Rare for long or very long periods
Permeability: Rapid in the sandy sediments and slow in the underlying glacial till
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Slow
Other properties: Ponding occurs in a cyclic pattern. The soil may be ponded continuously for several years and then not ponded for many years.

Inclusions

Contrasting inclusions:
• Minnewaukan soils, which are sandy throughout; on toe slopes slightly higher on the landscape than the Minnewasta soil
• The very poorly drained Oldham and Southam soils in basins

Similar inclusions:
• Soils that have more clay and less sand in the surface layer

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, and spring wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness, wind erosion
Management measures:
• In wet years this soil is better suited to late planted crops than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and deferring tillage when the soil is wet maintain tilth and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-1
Range site: Subirrigated
Windbreak suitability group: 10
Pasture suitability group: A

MtB—Minnewasta sandy loam, 2 to 6 percent slopes

Composition

Minnewasta and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Beach terraces
Position on the landform: Toe slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Surface layer:
0 to 6 inches—very dark gray, calcareous sandy loam

Underlying layer:
6 to 12 inches—light gray, mottled, calcareous sand
12 to 60 inches—light brownish gray and light gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 10 to 20 inches over glacial till
Seasonal high water table: At the surface to 3.5 feet below the surface
Flooding: None
Ponding: Rare for long or very long periods
Permeability: Rapid in the sandy sediments and slow in the underlying glacial till
Available water capacity: Moderate
Organic matter content: Moderately low
Surface runoff: Slow
Other properties: Ponding occurs in a cyclic pattern. The soil may be ponded continuously for several years and then not ponded for many years.

Inclusions

Contrasting inclusions:
• The well drained Maddock soils, which have sandy material throughout; on shoulder slopes
• The excessively drained Sioux soils, which have gravelly material within a depth of 14 inches; on shoulder slopes

Similar inclusions:
• Soils that have more clay and less sand in the surface layer

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, and spring wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness, wind erosion
Management measures:
• In wet years this soil is better suited to late planted crops than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and deferring tillage when the soil is wet maintain tilth and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-1
Range site: Subirrigated
Windbreak suitability group: 10
Pasture suitability group: A

Mw—Minnewaukan loamy sand

Composition

Minnewaukan and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Beach terraces
Position on the landform: Toe slopes
Slope range: 0 to 3 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—dark gray, calcareous loamy sand

Underlying layer:
6 to 55 inches—light brownish gray and gray, mottled, calcareous loamy fine sand and loamy sand
55 to 60 inches—gray, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over loamy material
Seasonal high water table: 0.5 foot above to 1.5 feet below the surface
Flooding: Occasional for long periods
Ponding: None
Permeability: Rapid
Available water capacity: Low
Organic matter content: Moderately low
Surface runoff: Very slow
Other properties: Ponding occurs in a cyclic pattern. The soil may be ponded continuously for several years and then not ponded for many years.

Inclusions

Contrasting inclusions:
• The poorly drained Colvin soils, which have more silt and less sand throughout than the Minnewaukan soil
• The somewhat poorly drained Mauvais soils, which have more clay and less sand throughout than the Minnewaukan soil
• The somewhat poorly drained Minnewasta soils, which

have less sand and more clay in the underlying material than the Minnewaukan soil
• The very poorly drained Oldham and Southam soils in basins

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, barley, oats, and spring wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness, wind erosion
Management measures:
• This soil is better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion and maintain the content of organic matter.
• Seeding cultivated areas to adapted grasses helps to control erosion.

Interpretive Groups

Land capability classification: IVw-1
Range site: Subirrigated
Windbreak suitability group: 2
Pasture suitability group: A

Mz—Moritz-Lowe loams

Composition

Moritz and similar soils: 50 to 65 percent
Lowe and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: Moritz—0 to 2 percent; Lowe—0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Moritz

Surface layer:
0 to 5 inches—very dark gray loam

Subsurface layer:
5 to 9 inches—dark gray, calcareous loam

Subsoil:
9 to 22 inches—light gray, calcareous silt loam
22 to 54 inches—light brownish gray, calcareous loam

Underlying layer:
54 to 60 inches—light brownish gray, mottled, calcareous loamy sand

Lowe

Surface layer:
0 to 10 inches—very dark gray, calcareous loam

Subsoil:
10 to 34 inches—gray, calcareous loam

Underlying layer:
34 to 56 inches—light gray, mottled, calcareous silt loam
56 to 60 inches—light gray, mottled, calcareous gravelly loam

Soil Properties and Qualities

Drainage class: Moritz—somewhat poorly drained; Lowe—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over gravelly material
Seasonal high water table: Moritz—at a depth of 1.5 to 3.0 feet; Lowe—at the surface to 1.5 feet below the surface
Flooding: Occasional for brief periods
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Moritz—moderate; Lowe—high
Surface runoff: Moritz—slow; Lowe—very slow
Other properties: Both soils have a high content of lime.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Divide soils, which are calcareous at or near the surface; on foot slopes
• The moderately well drained La Prairie soils, which are calcareous at a greater depth than the major soils; on high flood plains
• The poorly drained Playmoor soils, which have salts throughout; on low flood plains

Similar inclusions:
• Soils that have more sand and less silt than the Moritz soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, and sunflowers
Suitability for cropland: Well suited
Management concerns: Wetness, wind erosion, and the high content of lime, which adversely affects the

availability of plant nutrients
Management measures:
• In most years these soils are better suited to late planted crops than to other crops.
• Leaving crop residue on the surface and deferring tillage when the soils are wet help tilth, help to control erosion, and help to prevent surface compaction.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Moritz—IIe-4; Lowe—IVw-3
Range site: Moritz—Limy Subirrigated; Lowe—Subirrigated
Windbreak suitability group: Moritz—1; Lowe—10
Pasture suitability group: Moritz—K; Lowe—A

Od—Oldham silty clay loam

Composition

Oldham and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Basins
Slope range: 0 to 1 percent
Shape of areas: Oval
Size of areas: 5 to 80 acres

Typical Profile

Surface layer:
0 to 9 inches—dark gray, calcareous silty clay loam
Subsoil:
9 to 20 inches—very dark gray, calcareous silty clay loam
20 to 34 inches—dark gray, calcareous silty clay loam
34 to 42 inches—gray, calcareous silty clay loam
42 to 49 inches—gray, calcareous silty clay
Underlying layer:
49 to 60 inches—gray, calcareous silty clay

Soil Properties and Qualities

Drainage class: Very poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over glacial till
Depth to the water table: 0.5 foot to 1.5 feet
Flooding: None
Ponding: Occasional for brief periods
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Negligible
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The poorly drained Colvin and Vallers soils, which have more silt and less clay in the subsoil than the Oldham soil; on toe slopes
• The somewhat poorly drained Mauvais soils, which have more sand and less silt throughout than the Oldham soil; on toe slopes
• The poorly drained Playmoor soils, which have salts throughout; on low flood plains
• The very poorly drained Southam soils in basins that are ponded throughout the growing season
Similar inclusions:
• Soils that are not calcareous
• Soils that have less clay

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland and rangeland

Main crops: Undrained areas—unsuited to crops; drained areas—corn, soybeans, oats, and spring wheat
Suitability for cropland: Very poorly suited
Management concerns: Wetness, wind erosion
Management measures:
• Proper grazing management maintains plant vigor.
• Restricting grazing during wet periods helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: Vw-2
Range site: Wetland
Windbreak suitability group: 10
Pasture suitability group: B2

Og—Orthents, gravelly

Composition

Orthents and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Excavations and spoil areas
Slope range: 0 to 60 percent

Shape of areas: Irregular
Size of areas: 5 to 80 acres

Typical Profile

Surface layer:
0 to 20 inches—multicolored gravelly sandy loam
Underlying layer:
20 to 60 inches—multicolored clay loam

Soil Properties and Qualities

Drainage class: Excessively drained
Depth to bedrock: Very deep
Depth to contrasting layer: 0 to 10 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Very rapid
Available water capacity: Very low
Organic matter content: Low
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• Barnes soils, which do not have gravelly material above a depth of 40 inches; along the edges of the unit
• Embden soils, which formed in loamy sediments; on foot slopes along the edges of the unit
• The well drained Fordville soils, which have gravelly material at a depth of 20 to 40 inches; in undisturbed areas
• The somewhat excessively drained Renshaw soils, which have gravelly material at a depth of 14 to 20 inches; in undisturbed areas
Similar inclusions:
• Soils that have 7 to 12 inches of loamy topsoil over gravelly material; in reclaimed areas
• Some areas in which the water table is above the surface

Use and Management

Dominant land use: Wildlife habitat; source of sand and gravel for construction purposes
Other land use: Pasture
Management concerns: Very low available water capacity
Management measures:
• Abandoned gravel pits can be restored to range, tame pasture, or cropland if reclamation measures are applied.
• Shaping the area reduces the slope.
• Mounds of overburden can be used as topsoil dressing.
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.
• Applying fertilizer as needed helps to establish range or pasture plants.

Interpretive Groups

Land capability classification: VIIIs-1
Range site: Very Shallow
Windbreak suitability group: 10
Pasture suitability group: NS

Pa—Parnell silty clay loam

Composition

Parnell and similar soils: 90 to 99 percent
Contrasting inclusions: 1 to 10 percent

Setting

Landform: Till plains
Position on the landform: Basins
Slope range: 0 to 1 percent
Shape of areas: Oval
Size of areas: 5 to 80 acres

Typical Profile

Surface soil:
0 to 16 inches—very dark gray silty clay loam
Subsoil:
16 to 23 inches—dark gray, mottled silty clay loam
23 to 44 inches—dark gray, mottled silty clay
Underlying layer:
44 to 60 inches—gray, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Very poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: 1.0 foot above to 0.5 foot below the surface
Flooding: None
Ponding: Frequent for very long periods
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Negligible

Inclusions

Contrasting inclusions:
• The poorly drained Colvin and Vallers soils, which are calcareous at or near the surface; on toe slopes
• The somewhat poorly drained Cubden and Hamerly soils, which are calcareous at or near the surface; on foot slopes
• The poorly drained Tonka soils in the shallow parts of basins

Similar inclusions:
• Soils that are calcareous to the surface

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Wetness
Management measures:
• Proper grazing management maintains plant vigor.
• Restricting grazing during wet periods helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: Vw-2
Range site: Shallow Marsh
Windbreak suitability group: 10
Pasture suitability group: B2

PeA—Peever clay loam, 0 to 2 percent slopes

Composition

Peever and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Till plains
Position on the landform: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 8 inches—dark gray clay loam
Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 33 inches—grayish brown, calcareous clay loam
Underlying layer:
33 to 60 inches—olive gray, calcareous clay

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The moderately well drained Aastad soils, which have less clay in the subsoil than the Peever soil; on foot slopes
• The moderately well drained Cavour and Cresbard soils, which have a sodium-affected subsoil; on foot slopes
• The poorly drained Tonka soils in basins
• Soils that are calcareous closer to the surface than the Peever soil

Similar inclusions:
• Soils that have less clay throughout
• Soils that are dark to a depth of more than 16 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Slow rate of water infiltration, tilth
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and help to maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIs-1
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: E

PeB—Peever clay loam, 2 to 6 percent slopes

Composition

Peever and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Till plains
Position on the landform: Summits and back slopes
Slope range: 2 to 6 percent

Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 8 inches—dark gray clay loam
Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 33 inches—grayish brown, calcareous clay loam
Underlying layer:
33 to 60 inches—olive gray, calcareous clay

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Medium

Inclusions

Contrasting inclusions:
• Buse soils, which are calcareous at or near the surface; on shoulder slopes
• The moderately well drained Cavour and Cresbard soils, which have a sodium-affected subsoil; on foot slopes
• The poorly drained Tonka soils in basins
Similar inclusions:
• Soils that have less clay throughout
• Soils that are dark to a depth of more than 16 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Water erosion, slow rate of water infiltration, and tilth
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture, help to control water erosion, and help to maintain tilth and the content of organic matter.
• Contour farming and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular to be farmed on the contour.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe-3
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: E

Pf—Peever-Cavour complex

Composition

Peever and similar soils: 60 to 70 percent
Cavour and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Peever—summits and back slopes; Cavour—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 600 acres

Typical Profile

Peever

Surface layer:
0 to 8 inches—dark gray clay loam
Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 33 inches—grayish brown, calcareous clay loam
Underlying layer:
33 to 60 inches—olive gray, calcareous clay

Cavour

Surface layer:
0 to 9 inches—dark gray loam
Subsurface layer:
9 to 13 inches—gray loam
Subsoil:
13 to 18 inches—dark grayish brown clay
18 to 30 inches—dark grayish brown clay that has gypsum crystals and other salts
30 to 44 inches—light brownish gray, mottled, calcareous clay loam
Underlying layer:
44 to 56 inches—light brownish gray, mottled, calcareous clay loam
56 to 60 inches—pale olive, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Peever—well drained; Cavour—moderately well drained

Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Peever—greater than 6 feet; Cavour—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Peever—slow; Cavour—very slow
Available water capacity: Peever—high; Cavour—moderate
Organic matter content: Moderate
Surface runoff: Slow
Other properties: The Cavour soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• Cresbard soils, which have a subsoil that is less affected by sodium than that of the Cavour soil; on foot slopes
• Ferney soils, which have visible salts within a depth of 16 inches; on the lower foot slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have less clay throughout than the Peever soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Peever—slow rate of water infiltration; Cavour—slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and help to maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Peever—IIs-1; Cavour—IVs-2
Range site: Peever—Clayey; Cavour—Claypan
Windbreak suitability group: Peever—4; Cavour—9
Pasture suitability group: Peever—E; Cavour—C

Pk—Peever-Cresbard-Tonka complex

Composition

Peever and similar soils: 40 to 50 percent
Cresbard and similar soils: 20 to 30 percent
Tonka and similar soils: 10 to 20 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Till plains
Position on the landform: Peever—summits and back slopes; Cresbard—foot slopes; Tonka—basins
Slope range: Peever—0 to 2 percent; Cresbard—0 to 2 percent; Tonka—0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Peever

Surface layer:
0 to 8 inches—dark gray clay loam

Subsoil:
8 to 15 inches—dark grayish brown clay loam
15 to 33 inches—grayish brown, calcareous clay loam

Underlying layer:
33 to 60 inches—olive gray, calcareous clay

Cresbard

Surface layer:
0 to 9 inches—dark gray loam

Subsurface layer:
9 to 10 inches—gray loam

Transitional layer:
10 to 14 inches—gray and dark gray clay loam

Subsoil:
14 to 34 inches—dark gray and grayish brown silty clay
34 to 55 inches—grayish brown, mottled, calcareous clay loam

Underlying layer:
55 to 60 inches—light brownish gray, mottled, calcareous clay loam

Tonka

Surface layer:
0 to 14 inches—dark gray silty clay loam

Subsurface layer:
14 to 24 inches—gray, mottled silt loam

Subsoil:
24 to 46 inches—dark gray, mottled silty clay loam
46 to 53 inches—grayish brown, mottled silty clay loam

Underlying layer:
53 to 60 inches—light brownish gray, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Peever—well drained; Cresbard—moderately well drained; Tonka—poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: Peever—at a depth of more than 6 feet; Cresbard—at a depth of 3.5 to 5.0 feet; Tonka—0.5 foot above to 1.0 foot below the surface
Flooding: None
Ponding: Peever—none; Cresbard—none; Tonka—frequent for long periods
Permeability: Slow
Available water capacity: High
Organic matter content: Peever—moderate; Cresbard—moderate; Tonka—high
Surface runoff: Peever—slow; Cresbard—slow; Tonka—negligible
Other properties: The Cresbard soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The well drained Buse soils, which are calcareous at or near the surface; on shoulder slopes
• The somewhat poorly drained Hamerly soils, which are calcareous at or near the surface; on foot slopes
• The moderately well drained Ferney soils, which have visible salts within a depth of 16 inches; on foot slopes

Similar inclusions:
• Soils that have less clay throughout than the Peever soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Peever and Cresbard—alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat; Tonka—barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Well suited
Management concerns: Peever—slow rate of water infiltration; Cavour—slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration; Tonka—wetness, compaction if tilled when wet
Management measures:
• Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
• Chiseling and subsoiling when the soil is dry increase the rate of water infiltration.
• Delaying tillage when the Tonka soil is wet helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water on the Tonka soil.

Interpretive Groups

Land capability classification: Peever—IIs-1; Cresbard—IIIs-1; Tonka—IVw-1
Range site: Peever—Clayey; Cresbard—Clayey; Tonka—Wet Meadow
Windbreak suitability group: Peever—4; Cresbard—4; Tonka—10
Pasture suitability group: Peever—E; Cresbard—E; Tonka—B2

Pm—Playmoor silty clay loam

Composition

Playmoor and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 40 to 600 acres

Typical Profile

Surface layer:
0 to 6 inches—very dark gray, mottled, calcareous silty clay loam that has masses of salt

Subsoil:
6 to 27 inches—dark gray, mottled, calcareous silty clay loam that has masses of salt
27 to 37 inches—very dark gray, mottled, calcareous silty clay loam that has masses of salt
37 to 50 inches—dark gray, mottled, calcareous silty clay loam

Underlying layer:
50 to 60 inches—gray, mottled, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over glacial till or gravelly material
Seasonal high water table: At the surface to 1.5 feet below the surface
Flooding: Frequent for brief periods
Ponding: None
Permeability: Moderately slow
Available water capacity: Moderate

Organic matter content: High
Surface runoff: Very slow
Other properties: This soil is saline and has a high content of lime.

Inclusions

Contrasting inclusions:
• Ludden soils, which have more clay than the Playmoor soil; on low flood plains
• Ranslo soils, which have a sodium-affected subsoil; in the slightly higher positions on the landscape
• The well drained La Prairie soils, which do not have visible salts; on high flood plains

Similar inclusions:
• Soils that have less silt and more sand

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Barley, oats, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness; wind erosion; the high content of salt; the high content of lime, which adversely affects the availability of plant nutrients; and the risk of compaction if tilled when wet
Management measures:
• In most years this soil is better suited to late planted crops than to other crops.
• Leaving crop residue on the surface and deferring tillage when the soil is wet maintain tilth, help to prevent surface compaction, and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Salt-tolerant species should be selected for planting.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-4
Range site: Saline Subirrigated
Windbreak suitability group: 10
Pasture suitability group: J

PnB—Poinsett-Buse-Waubay complex, 1 to 6 percent slopes

Composition

Poinsett and similar soils: 30 to 40 percent
Buse and similar soils: 20 to 30 percent
Waubay and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Poinsett—summits and back slopes; Buse—shoulder slopes; Waubay—foot slopes
Slope range: Poinsett—2 to 6 percent; Buse—3 to 6 percent; Waubay—1 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 200 acres

Typical Profile

Poinsett

Surface layer:
0 to 8 inches—very dark gray silty clay loam

Subsoil:
8 to 15 inches—brown silty clay loam
15 to 26 inches—light olive brown silt loam
26 to 36 inches—light yellowish brown, calcareous silt loam
36 to 48 inches—light yellowish brown, mottled, calcareous silt loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous silt loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Waubay

Surface soil:
0 to 12 inches—very dark gray silty clay loam

Subsoil:
12 to 17 inches—dark gray silty clay loam
17 to 23 inches—brown silty clay loam
23 to 39 inches—light yellowish brown, calcareous silt loam

Underlying layer:
39 to 60 inches—light gray and grayish brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Poinsett—well drained; Buse—well drained; Waubay—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Poinsett—40 to more than 60 inches over loamy glacial till; Buse—greater than 60

inches; Waubay—40 to more than 60 inches over loamy glacial till
Depth to the water table: Poinsett—greater than 6 feet; Buse—greater than 6 feet; Waubay—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Poinsett—moderate; Buse—moderately slow; Waubay—moderate
Available water capacity: High
Organic matter content: Poinsett—high; Buse—moderately low; Waubay—high
Surface runoff: Poinsett—medium; Buse—medium; Waubay—slow
Other properties: The Buse soil has a high content of lime. Runoff water flows over the Waubay soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Badger soils on toe slopes
• Cubden soils, which are calcareous at or near the surface; on foot slopes
• The very poorly drained Parnell and poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more sand and less silt between the depths of 20 and 40 inches than the Poinsett soil
• Soils that have more silt throughout than the Buse soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Poinsett—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Waubay—only slight limitations
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular to be farmed on the contour.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Poinsett—IIe-3; Buse—IIIe-6; Waubay—I-3
Range site: Poinsett—Silty; Buse—Thin Upland; Waubay—Loamy Overflow
Windbreak suitability group: Poinsett—3; Buse—8; Waubay—1
Pasture suitability group: Poinsett—F; Buse—G; Waubay—K

PnC—Poinsett-Buse-Waubay complex, 2 to 9 percent slopes

Composition

Poinsett and similar soils: 35 to 45 percent
Buse and similar soils: 30 to 40 percent
Waubay and similar soils: 10 to 20 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Poinsett—back slopes; Buse—shoulder slopes; Waubay—foot slopes
Slope range: Poinsett—6 to 9 percent; Buse—6 to 9 percent; Waubay—2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Poinsett

Surface layer:
0 to 8 inches—very dark gray silty clay loam

Subsoil:
8 to 15 inches—brown silty clay loam
15 to 26 inches—light olive brown silt loam
26 to 36 inches—light yellowish brown, calcareous silt loam
36 to 48 inches—light yellowish brown, mottled, calcareous silt loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous silt loam

Buse

Surface layer:
0 to 7 inches—dark gray, calcareous loam

Subsoil:
7 to 20 inches—pale yellow, calcareous clay loam

Underlying layer:
20 to 60 inches—pale yellow, mottled, calcareous clay loam

Waubay

Surface soil:
0 to 12 inches—very dark gray silty clay loam

Subsoil:
12 to 17 inches—dark gray silty clay loam
17 to 23 inches—brown silty clay loam
23 to 39 inches—light yellowish brown, calcareous silt loam

Underlying layer:
39 to 60 inches—light gray and grayish brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Poinsett—well drained; Buse—well drained; Waubay—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Poinsett—40 to more than 60 inches over loamy glacial till; Buse—greater than 60 inches; Waubay—40 to more than 60 inches over loamy glacial till
Depth to the water table: Poinsett—greater than 6 feet; Buse—greater than 6 feet; Waubay—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Poinsett—moderate; Buse—moderately slow; Waubay—moderate
Available water capacity: High
Organic matter content: Poinsett—high; Buse—moderately low; Waubay—high
Surface runoff: Medium
Other properties: The Buse soil has a high content of lime. Runoff water flows over the Waubay soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Badger soils on toe slopes
• The somewhat poorly drained Cubden soils in the slightly higher areas near basins
• The very poorly drained Parnell and poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more sand between the depths of 10 and 40 inches than the Poinsett soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Poinsett—water erosion; Buse—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Waubay—only slight limitations

Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming, terraces, and grassed waterways help to control water erosion, but slopes in some areas are too short and too irregular for terraces or for contour farming.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter, fertility, and tilth.

Interpretive Groups

Land capability classification: Poinsett—IIIe-2; Buse—IVe-2; Waubay—IIe-1
Range site: Poinsett—Silty; Buse—Thin Upland; Waubay—Silty
Windbreak suitability group: Poinsett—3; Buse—8; Waubay—1
Pasture suitability group: Poinsett—F; Buse—G; Waubay—K

PoC—Poinsett-Rusklyn silty clay loams, 6 to 9 percent slopes

Composition

Poinsett and similar soils: 50 to 60 percent
Rusklyn and similar soils: 30 to 45 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Moraines
Position on the landform: Poinsett—back slopes; Rusklyn—shoulder slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

Poinsett

Surface layer:
0 to 8 inches—very dark gray silty clay loam

Subsoil:
8 to 15 inches—brown silty clay loam
15 to 26 inches—light olive brown silt loam
26 to 36 inches—light yellowish brown, calcareous silt loam
36 to 48 inches—light yellowish brown, mottled, calcareous silt loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous silt loam

Rusklyn

Surface layer:
0 to 10 inches—dark grayish brown, calcareous silty clay loam
Subsoil:
10 to 18 inches—light gray, mottled, calcareous silt loam
18 to 33 inches—light yellowish brown, mottled, calcareous silt loam
Underlying layer:
33 to 48 inches—light gray, mottled, calcareous silt loam
48 to 60 inches—light gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over loamy glacial till
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Poinsett—high; Rusklyn—moderately low
Surface runoff: Medium
Other properties: The Rusklyn soil has a high content of lime.

Inclusions

Contrasting inclusions:
• Egeland soils, which have less clay and more sand than the major soils; on back slopes
• Maddock soils, which have less clay and more sand than the major soils; on shoulder slopes
• The moderately well drained Waubay soils, which are dark to a depth of more than 16 inches; on foot slopes
Similar inclusions:
• Soils that have less silt and more sand than the Rusklyn soil
• Soils that have clay loam underlying material at a depth of 20 to 40 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Poinsett—water erosion; Rusklyn—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming, terraces, and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular for terraces or for contour farming.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Poinsett—IIIe-2; Rusklyn—IVe-2
Range site: Poinsett—Silty; Rusklyn—Thin Upland
Windbreak suitability group: Poinsett—3; Rusklyn—8
Pasture suitability group: Poinsett—F; Rusklyn—G

PrB—Poinsett-Rusklyn-Waubay silty clay loams, 1 to 6 percent slopes

Composition

Poinsett and similar soils: 30 to 45 percent
Rusklyn and similar soils: 20 to 35 percent
Waubay and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Poinsett—summits and back slopes; Rusklyn—shoulder slopes; Waubay—foot slopes
Slope range: Poinsett—2 to 6 percent; Rusklyn—2 to 6 percent; Waubay—1 to 2 percent
Shape of areas: Irregular
Size of areas: 40 to 200 acres

Typical Profile

Poinsett

Surface layer:
0 to 8 inches—very dark gray silty clay loam
Subsoil:
8 to 15 inches—brown silty clay loam
15 to 26 inches—light olive brown silt loam
26 to 36 inches—light yellowish brown, calcareous silt loam
36 to 48 inches—light yellowish brown, mottled, calcareous silt loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous silt loam

Rusklyn

Surface layer:
0 to 10 inches—dark grayish brown, calcareous silty clay loam

Subsoil:
10 to 18 inches—light gray, mottled, calcareous silt loam
18 to 33 inches—light yellowish brown, mottled, calcareous silt loam

Underlying layer:
33 to 48 inches—light gray, mottled, calcareous silt loam
48 to 60 inches—light gray, mottled, calcareous clay loam

Waubay

Surface soil:
0 to 12 inches—very dark gray silty clay loam

Subsoil:
12 to 17 inches—dark gray silty clay loam
17 to 23 inches—brown silty clay loam
23 to 39 inches—light yellowish brown, calcareous silt loam

Underlying layer:
39 to 60 inches—light gray and grayish brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Poinsett—well drained; Rusklyn—well drained; Waubay—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over loamy glacial till
Depth to the water table: Poinsett—greater than 6 feet; Rusklyn—greater than 6 feet; Waubay—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: Poinsett—high; Rusklyn—moderately low; Waubay—high
Surface runoff: Poinsett—medium; Rusklyn—medium; Waubay—slow
Other properties: The Rusklyn soil has a high content of lime. Runoff water flows over the Waubay soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The well drained Barnes soils, which have less silt and more sand than the major soils; on back slopes
• The very poorly drained Parnell and poorly drained Tonka soils in basins
• The somewhat poorly drained Cubden soils on foot slopes

Similar inclusions:
• Soils that have less silt and more sand than the Rusklyn soil
• Soils that have clay loam underlying material at a depth of 20 to 40 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Poinsett—water erosion; Rusklyn—wind erosion, water erosion, and the high content of lime, which adversely affects the availability of plant nutrients; Waubay—only slight limitations
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular to be farmed on the contour.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: Poinsett—IIe-3; Rusklyn—IIIe-6; Waubay—I-3
Range site: Poinsett—Silty; Rusklyn—Thin Upland; Waubay—Loamy Overflow
Windbreak suitability group: Poinsett—3; Rusklyn—8; Waubay—1
Pasture suitability group: Poinsett—F; Rusklyn—G; Waubay—K

PwA—Poinsett-Waubay silty clay loams, 0 to 2 percent slopes

Composition

Poinsett and similar soils: 50 to 60 percent
Waubay and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Poinsett—summits and back slopes; Waubay—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Poinsett

Surface layer:
0 to 8 inches—very dark gray silty clay loam

Subsoil:
8 to 15 inches—brown silty clay loam
15 to 26 inches—light olive brown silt loam
26 to 36 inches—light yellowish brown, calcareous silt loam
36 to 48 inches—light yellowish brown, mottled, calcareous silt loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous silt loam

Waubay

Surface soil:
0 to 12 inches—very dark gray silty clay loam

Subsoil:
12 to 17 inches—dark gray silty clay loam
17 to 23 inches—brown silty clay loam
23 to 39 inches—light yellowish brown, calcareous silt loam

Underlying layer:
39 to 60 inches—light gray and grayish brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Poinsett—well drained; Waubay—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over loamy glacial till
Depth to the water table: Poinsett—greater than 6 feet; Waubay—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: Runoff water flows over the Waubay soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• Rusklyn and Buse soils, which are calcareous at or near the surface; on shoulder slopes
• The poorly drained Tonka soils in basins
• The somewhat poorly drained Badger soils on toe slopes
• The somewhat poorly drained Cubden soils on the edges of basins

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Only slight limitations
Management measures:
• Managing crop residue conserves moisture and helps to maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Poinsett—I-2; Waubay—I-3
Range site: Poinsett—Silty; Waubay—Loamy Overflow
Windbreak suitability group: Poinsett—3; Waubay—1
Pasture suitability group: Poinsett—F; Waubay—K

PwB—Poinsett-Waubay silty clay loams, 1 to 6 percent slopes

Composition

Poinsett and similar soils: 60 to 70 percent
Waubay and similar soils: 20 to 30 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Poinsett—summits and back slopes; Waubay—foot slopes
Slope range: Poinsett—2 to 6 percent; Waubay—1 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Poinsett

Surface layer:
0 to 8 inches—very dark gray silty clay loam

Subsoil:
8 to 15 inches—brown silty clay loam
15 to 26 inches—light olive brown silt loam

26 to 36 inches—light yellowish brown, calcareous silt loam
36 to 48 inches—light yellowish brown, mottled, calcareous silt loam

Underlying layer:
48 to 60 inches—light yellowish brown, mottled, calcareous silt loam

Waubay

Surface soil:
0 to 12 inches—very dark gray silty clay loam

Subsoil:
12 to 17 inches—dark gray silty clay loam
17 to 23 inches—brown silty clay loam
23 to 39 inches—light yellowish brown, calcareous silt loam

Underlying layer:
39 to 60 inches—light gray and grayish brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Poinsett—well drained; Waubay—moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over loamy glacial till
Depth to the water table: Poinsett—greater than 6 feet; Waubay—3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Poinsett—medium; Waubay—slow
Other properties: Runoff water flows over the Waubay soil during periods of rainfall and snowmelt.

Inclusions

Contrasting inclusions:
• Rusklyn and Buse soils, which are calcareous at or near the surface; on shoulder slopes
• The poorly drained Tonka soils in basins
• The somewhat poorly drained Badger soils on toe slopes
• The somewhat poorly drained Cubden soils on the edges of basins

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Poinsett—water erosion; Waubay—only slight limitations
Management measures:
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Contour farming and grassed waterways help to control water erosion, but slopes in some areas are too short or too irregular to be farmed on the contour.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: Poinsett—IIe-3; Waubay—I-3
Range site: Poinsett—Silty; Waubay—Loamy Overflow
Windbreak suitability group: Poinsett—3; Waubay—1
Pasture suitability group: Poinsett—F; Waubay—K

Ra—Ranslo silty clay loam

Composition

Ranslo and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 10 to 20 acres

Typical Profile

Surface layer:
0 to 6 inches—gray silty clay loam

Subsoil:
6 to 12 inches—dark gray silty clay
12 to 24 inches—dark gray silty clay that has masses of salt
24 to 30 inches—gray, calcareous clay loam that has masses of salt

Underlying layer:
30 to 36 inches—grayish brown, mottled, calcareous clay loam
36 to 60 inches—gray, calcareous sandy clay loam

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 1 to 3 feet
Flooding: Occasional for very brief periods
Ponding: None
Permeability: Slow

Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow
Other properties: This soil has a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The poorly drained Harriet soils, which have a thinner surface layer than the Ranslo soil; on low flood plains
• The poorly drained Ludden soils, which do not have a sodium-affected subsoil; on low flood plains
• The poorly drained Playmoor soils, which do not have a sodium-affected subsoil, have less clay in the subsoil than the Ranslo soil, and have salts at the surface; on low flood plains
• The poorly drained Lowe soils, which do not have a sodium-affected subsoil and have less clay in the subsoil than the Ranslo soil; on low flood plains

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Barley, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: Wetness; the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration; a slow rate of water infiltration; and the risk of surface compaction if tilled when wet
Management measures:
• Leaving crop residue on the surface and deferring tillage until the soil is dry maintain tilth and help to prevent surface compaction.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IVs-2
Range site: Subirrigated
Windbreak suitability group: 9
Pasture suitability group: C

Re—Rauville silty clay loam

Composition

Rauville and similar soils: 80 to 90 percent
Contrasting inclusions: 10 to 20 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Long and narrow
Size of areas: 40 to 300 acres

Typical Profile

Surface layer:
0 to 10 inches—dark gray, mottled, calcareous silty clay loam

Subsurface layer:
10 to 31 inches—dark gray, calcareous silt loam

Transitional layer:
31 to 41 inches—gray, calcareous silty clay loam

Subsoil:
41 to 58 inches—gray, calcareous silty clay loam

Underlying layer:
58 to 60 inches—light gray, calcareous silty clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over gravelly material
Seasonal high water table: At the surface to 0.5 foot below the surface
Flooding: Frequent for long periods
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Very slow
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The moderately well drained Divide soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The poorly drained Lowe soils on low flood plains
• The poorly drained Marysland soils, which have gravelly material at a depth of 20 to 40 inches; on toe slopes

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Wetness, surface compaction if grazed when wet

Management measures:
• Proper grazing management maintains plant vigor.
• Restricting grazing during wet periods helps to prevent surface compaction.

Interpretive Groups

Land capability classification: Vw-1
Range site: Wetland
Windbreak suitability group: 10
Pasture suitability group: B1

RfA—Renshaw-Fordville loams, 0 to 2 percent slopes

Composition

Renshaw and similar soils: 50 to 60 percent
Fordville and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Renshaw—summits and back slopes; Fordville—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Renshaw

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 16 inches—brown loam
16 to 19 inches—light yellowish brown, calcareous loam

Underlying layer:
19 to 60 inches—light gray, calcareous very gravelly loamy sand

Fordville

Surface layer:
0 to 7 inches—very dark gray loam

Subsoil:
7 to 24 inches—dark grayish brown loam
24 to 28 inches—brown loam

Underlying layer:
28 to 43 inches—brown, calcareous very gravelly loamy sand
43 to 60 inches—light brownish gray, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Renshaw—somewhat excessively drained; Fordville—well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Renshaw—14 to 20 inches over gravelly material; Fordville—20 to 40 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Renshaw—low; Fordville—moderate
Organic matter content: Renshaw—moderate; Fordville—high
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Divide soils, which are calcareous at or near the surface; on foot slopes
• The moderately well drained Egeland soils, which formed in loamy sediments; on back slopes
• The moderately well drained Embden soils, which formed in loamy sediments; on foot slopes along the edges of the unit
• The excessively drained Sioux soils, which have gravelly material within a depth of 14 inches; on shoulder slopes
• The somewhat poorly drained Spottswood soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes

Similar inclusions:
• Soils that have gravelly material at a depth of 40 to 60 inches

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Renshaw—low available water capacity; Fordville—moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Irrigation helps to overcome the limited available water capacity if water is of adequate quantity and quality.

Interpretive Groups

Land capability classification: Renshaw—IIIs-3; Fordville—IIs-3
Range site: Renshaw—Shallow to Gravel; Fordville—Silty
Windbreak suitability group: Renshaw—6; Fordville—6
Pasture suitability group: Renshaw—D2; Fordville—D1

RfB—Renshaw-Fordville loams, 2 to 6 percent slopes

Composition

Renshaw and similar soils: 50 to 60 percent
Fordville and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Renshaw—summits and back slopes; Fordville—foot slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Renshaw

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 16 inches—brown loam
16 to 19 inches—light yellowish brown, calcareous loam

Underlying layer:
19 to 60 inches—light gray, calcareous very gravelly loamy sand

Fordville

Surface layer:
0 to 7 inches—very dark gray loam

Subsoil:
7 to 24 inches—dark grayish brown loam
24 to 28 inches—brown loam

Underlying layer:
28 to 43 inches—brown, calcareous very gravelly loamy sand
43 to 60 inches—light brownish gray, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Renshaw—somewhat excessively drained; Fordville—well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Renshaw—14 to 20 inches over gravelly material; Fordville—20 to 40 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Renshaw—low; Fordville—moderate
Organic matter content: Renshaw—moderate; Fordville—high
Surface runoff: Medium

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Divide soils, which are calcareous at or near the surface; on foot slopes
• The moderately well drained Egeland soils, which formed in loamy sediments; on back slopes along the edges of the unit
• The moderately well drained Egeland and Embden soils, which formed in loamy sediments; on foot slopes along the edges of the unit
• The excessively drained Sioux soils, which have gravelly material within a depth of 14 inches; on shoulder slopes

Use and Management

Dominant land use: Cropland (fig. 10) and pasture
Other land use: Rangeland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Poorly suited
Management concerns: Renshaw—water erosion, low available water capacity; Fordville—water erosion, moderate available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Irrigation helps to overcome the limited available water capacity if water is of adequate quantity and quality.

Interpretive Groups

Land capability classification: Renshaw—IVs-2; Fordville—IIe-5
Range site: Renshaw—Shallow to Gravel; Fordville—Silty
Windbreak suitability group: Renshaw—6; Fordville—6
Pasture suitability group: Renshaw—D2; Fordville—D1

Figure 10.—Farming on the contour in an area of Renshaw-Fordville loams, 2 to 6 percent slopes.

RsA—Renshaw-Sioux complex, 0 to 2 percent slopes

Composition

Renshaw and similar soils: 50 to 60 percent
Sioux and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Renshaw—summits and back slopes; Sioux—shoulder slopes
Slope range: Renshaw—0 to 2 percent; Sioux—1 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 40 acres

Typical Profile

Renshaw

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 16 inches—brown loam
16 to 19 inches—light yellowish brown, calcareous loam

Underlying layer:
19 to 60 inches—light gray, calcareous very gravelly loamy sand

Sioux

Surface layer:
0 to 7 inches—very dark gray, calcareous gravelly loam

Transitional layer:
7 to 11 inches—dark grayish brown, calcareous gravelly loam

Underlying layer:
11 to 26 inches—light brownish gray, calcareous very gravelly loamy sand
26 to 60 inches—light yellowish brown and pale brown, calcareous very gravelly sand

Soil Properties and Qualities

Drainage class: Renshaw—somewhat excessively drained; Sioux—excessively drained
Depth to bedrock: Very deep
Depth to contrasting layer: Renshaw—14 to 20 inches over gravelly material; Sioux—6 to 14 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Renshaw—moderate in the loamy sediments and very rapid in the underlying gravelly material; Sioux—very rapid
Available water capacity: Renshaw—low; Sioux—very low
Organic matter content: Renshaw—moderate; Sioux—moderately low
Surface runoff: Renshaw—slow; Sioux—very slow

Inclusions

Contrasting inclusions:
• The well drained Egeland soils, which formed in loamy sediments; on back slopes, generally along the edges of the unit
• The moderately well drained Spottswood soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The well drained Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes

Similar inclusions:
• Soils that have a thinner surface layer than the Sioux soil
• Soils that have more sand and less gravel in the underlying material than the Renshaw soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Renshaw—alfalfa, barley, oats, and spring wheat; Sioux—generally unsuited
Suitability for cropland: Fairly well suited
Management concerns: Renshaw—low available water capacity; Sioux—very low available water capacity
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Seeding cultivated areas to adapted grasses helps to control erosion.

Interpretive Groups

Land capability classification: Renshaw—IIIs-3; Sioux—VIs-3
Range site: Renshaw—Shallow to Gravel; Sioux—Very Shallow
Windbreak suitability group: Renshaw—6; Sioux—10
Pasture suitability group: Renshaw—D2; Sioux—NS

RsB—Renshaw-Sioux complex, 2 to 6 percent slopes

Composition

Renshaw and similar soils: 50 to 60 percent
Sioux and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Renshaw—summits and back slopes; Sioux—shoulder slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 5 to 100 acres

Typical Profile

Renshaw

Surface layer:
0 to 8 inches—dark gray loam

Subsoil:
8 to 16 inches—brown loam
16 to 19 inches—light yellowish brown, calcareous loam

Underlying layer:
19 to 60 inches—light gray, calcareous very gravelly loamy sand

Sioux

Surface layer:
0 to 7 inches—very dark gray, calcareous gravelly loam

Transitional layer:
7 to 11 inches—dark grayish brown, calcareous gravelly loam

Underlying layer:
11 to 26 inches—light brownish gray, calcareous very gravelly loamy sand
26 to 60 inches—light yellowish brown and pale brown, calcareous very gravelly sand

Soil Properties and Qualities

Drainage class: Renshaw—somewhat excessively drained; Sioux—excessively drained
Depth to bedrock: Very deep
Depth to contrasting layer: Renshaw—14 to 20 inches over gravelly material; Sioux—6 to 14 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Renshaw—moderate in the loamy sediments and very rapid in the underlying gravelly material; Sioux—very rapid
Available water capacity: Renshaw—low; Sioux—very low
Organic matter content: Renshaw—moderate; Sioux—moderately low
Surface runoff: Renshaw—medium; Sioux—very slow

Inclusions

Contrasting inclusions:
• The well drained Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The moderately well drained Spottswood soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The well drained Egeland soils, which formed in loamy sediments; on back slopes, generally along the edges of the unit

Similar inclusions:
• Soils that have a thinner surface layer than the Sioux soil
• Soils that have more sand and less gravel in the underlying material than the Renshaw soil

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Renshaw—alfalfa, barley, oats, and spring wheat; Sioux—generally unsuited
Suitability for cropland: Poorly suited
Management concerns: Renshaw—low available water capacity, water erosion; Sioux—very low available water capacity, water erosion
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface help to control erosion and conserve moisture.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Seeding cultivated areas to adapted grasses helps to control erosion.

Interpretive Groups

Land capability classification: Renshaw—IVs-2; Sioux—VIs-3
Range site: Renshaw—Shallow to Gravel; Sioux—Very Shallow
Windbreak suitability group: Renshaw—6; Sioux—10
Pasture suitability group: Renshaw—D2; Sioux—NS

RsC—Renshaw-Sioux complex, 6 to 9 percent slopes

Composition

Renshaw and similar soils: 45 to 55 percent
Sioux and similar soils: 35 to 45 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Moraines
Position on the landform: Renshaw—back slopes; Sioux—shoulder slopes
Slope range: 6 to 9 percent
Shape of areas: Irregular
Size of areas: 10 to 40 acres

Typical Profile

Renshaw

Surface layer:
0 to 8 inches—dark gray loam
Subsoil:
8 to 16 inches—brown loam
16 to 19 inches—light yellowish brown, calcareous loam
Underlying layer:
19 to 60 inches—light gray, calcareous very gravelly loamy sand

Sioux

Surface layer:
0 to 7 inches—very dark gray, calcareous gravelly loam
Transitional layer:
7 to 11 inches—dark grayish brown, calcareous gravelly loam
Underlying layer:
11 to 26 inches—light brownish gray, calcareous very gravelly loamy sand
26 to 60 inches—light yellowish brown and pale brown,

calcareous very gravelly sand

Soil Properties and Qualities

Drainage class: Renshaw—somewhat excessively drained; Sioux—excessively drained
Depth to bedrock: Very deep
Depth to contrasting layer: Renshaw—14 to 20 inches over gravelly material; Sioux—6 to 14 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Renshaw—moderate in the loamy sediments and very rapid in the underlying gravelly material; Sioux—very rapid
Available water capacity: Renshaw—low; Sioux—very low
Organic matter content: Renshaw—moderate; Sioux—moderately low
Surface runoff: Renshaw—medium; Sioux—slow

Inclusions

Contrasting inclusions:
• The well drained Fordville soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The moderately well drained Spottswood soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The well drained Egeland soils, which formed in loamy sediments; on back slopes, generally along the edges of the unit

Similar inclusions:
• Soils that have a thinner surface layer than the Sioux soil
• Soils that have more sand and less gravel in the underlying material than the Renshaw soil

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Renshaw—alfalfa, barley, oats, and spring wheat; Sioux—generally unsuited
Suitability for cropland: Poorly suited
Management concerns: Renshaw—low available water capacity, water erosion; Sioux—very low available water capacity, water erosion
Management measures:
• These soils are better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface help to control water erosion and conserve moisture.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Seeding cultivated areas to adapted grasses helps to control erosion.

Interpretive Groups

Land capability classification: Renshaw—IVe-4; Sioux—VIs-3
Range site: Renshaw—Shallow to Gravel; Sioux—Very Shallow
Windbreak suitability group: Renshaw—6; Sioux—10
Pasture suitability group: Renshaw—D2; Sioux—NS

Sa—Salmo silty clay loam

Composition

Salmo and similar soils: 80 to 95 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Flood plains
Position on the landform: Low flood plains
Slope range: 0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 40 acres

Typical Profile

Surface layer:
0 to 7 inches—very dark gray, calcareous silty clay loam that has masses of salt

Subsoil:
7 to 32 inches—dark gray, calcareous silty clay loam that has masses of salt
32 to 40 inches—dark gray, calcareous silty clay loam

Underlying layer:
40 to 60 inches—dark gray, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over gravelly material
Seasonal high water table: At the surface to 1.5 feet below the surface
Flooding: Frequent for brief periods
Ponding: None
Permeability: Moderately slow
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Very slow
Other properties: This soil is saline and has a high content of lime.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Farmsworth soils, which have a sodium-affected subsoil; on low flood plains
• The somewhat poorly drained Lamo soils on low flood plains
• The moderately well drained Bon soils on high flood plains

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Barley, oats, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness; wind erosion; the high content of lime, which adversely affects the availability of plant nutrients; and the risk of surface compaction if tilled when wet
Management measures:
• In most years this soil is better suited to late planted crops than to other crops.
• Leaving crop residue on the surface and deferring tillage when the soil is wet maintain tilth, help to prevent surface compaction, and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Salt-tolerant species should be selected for planting.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-4
Range site: Saline Subirrigated
Windbreak suitability group: 10
Pasture suitability group: J

SnA—Sinai silty clay, 0 to 2 percent slopes

Composition

Sinai and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Ice-walled lake plains
Position on the landform: Summits and back slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark gray silty clay
Subsoil:
9 to 23 inches—dark gray silty clay
23 to 28 inches—gray, calcareous silty clay
28 to 32 inches—light gray, calcareous silty clay
Underlying layer:
32 to 55 inches—gray, calcareous silty clay
55 to 60 inches—light gray, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• Barnes soils, which have more sand and less clay than the Sinai soil; in positions on the landscape similar to those of the Sinai soil
• Poinsett soils, which have more silt and less clay than the Sinai soil; in positions on the landscape similar to those of the Sinai soil
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more silt and less clay

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Tilth, wind erosion, and a low rate of water infiltration
Management measures:
• Leaving crop residue on the surface, minimizing tillage, tilling in a timely manner, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and maintain tilth and the content of organic matter.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Chiseling or subsoiling when the soil is dry can

increase the rate of water infiltration.

Interpretive Groups

Land capability classification: IIs-2
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

SnB—Sinai silty clay, 2 to 6 percent slopes

Composition

Sinai and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Ice-walled plains
Position on the landform: Summits and back slopes
Slope range: 2 to 6 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark gray silty clay
Subsoil:
9 to 23 inches—dark gray silty clay
23 to 28 inches—gray, calcareous silty clay
28 to 32 inches—light gray, calcareous silty clay
Underlying layer:
32 to 55 inches—gray, calcareous silty clay
55 to 60 inches—light gray, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Very slow
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Medium

Inclusions

Contrasting inclusions:
• Barnes soils, which have more sand and less clay than the Sinai soil; in positions on the landscape similar to those of the Sinai soil
• Poinsett soils, which have more silt and less clay than the Sinai soil; in positions on the landscape similar to those of the Sinai soil
• The poorly drained Tonka soils in basins
Similar inclusions:
• Soils that have more silt and less clay

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, corn, oats, soybeans, and spring wheat
Suitability for cropland: Fairly well suited
Management concerns: Wind erosion, water erosion, slow rate of water infiltration, and tilth
Management measures:
• Leaving crop residue on the surface, minimizing tillage, tilling in a timely manner, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and maintain tilth and the content of organic matter.
• Contour farming and grassed waterways help to control erosion, but slopes in some areas are too short or too irregular to be farmed on the contour.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: IIIe-3
Range site: Clayey
Windbreak suitability group: 4
Pasture suitability group: I

SrD—Sioux-Renshaw complex, 9 to 15 percent slopes

Composition

Sioux and similar soils: 50 to 60 percent
Renshaw and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 20 percent

Setting

Landform: Moraines
Position on the landform: Sioux—shoulder slopes; Renshaw—back slopes
Slope range: 9 to 15 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Sioux

Surface layer:
0 to 7 inches—very dark gray, calcareous gravelly loam

Transitional layer:
7 to 11 inches—dark grayish brown, calcareous gravelly loam
Underlying layer:
11 to 26 inches—light brownish gray, calcareous very gravelly loamy sand
26 to 60 inches—light yellowish brown and pale brown, calcareous very gravelly sand

Renshaw

Surface layer:
0 to 8 inches—dark gray loam
Subsoil:
8 to 16 inches—brown loam
16 to 19 inches—light yellowish brown, calcareous loam
Underlying layer:
19 to 60 inches—light gray, calcareous very gravelly loamy sand

Soil Properties and Qualities

Drainage class: Sioux—excessively drained; Renshaw—somewhat excessively drained
Depth to bedrock: Very deep
Depth to contrasting layer: Sioux—6 to 14 inches over gravelly material; Renshaw—14 to 20 inches over gravelly material
Depth to the water table: Greater than 6 feet
Flooding: None
Ponding: None
Permeability: Sioux—very rapid; Renshaw—moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Sioux—very low; Renshaw—low
Organic matter content: Sioux—moderately low; Renshaw—moderate
Surface runoff: Sioux—slow; Renshaw—rapid

Inclusions

Contrasting inclusions:
• The moderately well drained Aastad soils, which are dark to a depth of more than 16 inches and are not underlain by gravelly material; on foot slopes
• The well drained Buse soils, which are not underlain by gravelly material; on shoulder slopes
Similar inclusions:
• Soils that are deeper to gravelly material and have more sand in the surface layer than the Sioux soil
• Soils that are dark to a depth of more than 16 inches and are deeper to gravelly material than the Renshaw soil

Use and Management

Dominant land use: Rangeland
Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Sioux—water erosion, very low available water capacity; Renshaw—water erosion, low available water capacity
Management measures:
• Proper grazing management maintains plant vigor, conserves moisture, and helps to control erosion.
• Seeding cultivated areas to adapted grasses helps to control erosion.

Interpretive Groups

Land capability classification: Sioux—VIs-3; Renshaw—VIe-6
Range site: Sioux—Very Shallow; Renshaw—Shallow to Gravel
Windbreak suitability group: Sioux—10; Renshaw—10
Pasture suitability group: Sioux—NS; Renshaw—NS

Ss—Southam silty clay loam

Composition

Southam and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Basins
Slope range: 0 to 1 percent
Shape of areas: Oval
Size of areas: 5 to 800 acres

Typical Profile

Surface layer:
0 to 9 inches—gray, calcareous silty clay loam
Subsurface layer:
9 to 19 inches—gray, mottled, calcareous silty clay loam
Transitional layer:
19 to 31 inches—dark gray, calcareous silty clay
Underlying layer:
31 to 50 inches—dark gray, mottled, calcareous silty clay
50 to 60 inches—gray, calcareous silty clay

Soil Properties and Qualities

Drainage class: Very poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: 5 feet above to 1 foot below the surface
Flooding: None

Ponding: Frequent for very long periods (fig. 11)
Permeability: Slow
Available water capacity: High
Organic matter content: Very high
Surface runoff: Negligible

Inclusions

Contrasting inclusions:
• The poorly drained Vallers and somewhat poorly drained Mauvais soils, which are dark to a depth of less than 24 inches; on toe slopes
• The somewhat poorly drained Minnewasta soils, which have more sand at the surface than the Southam soil; on toe slopes

Similar inclusions:
• Soils that are less calcareous in the surface layer
• Soils that are ponded for shorter periods

Use and Management

Dominant land use: Wildlife habitat
Other land use: Pasture

Cropland

Suitability for cropland: Unsuited because of wetness

Interpretive Groups

Land capability classification: VIIIw-1
Range site: Not assigned
Windbreak suitability group: 10
Pasture suitability group: NS

Sw—Spottswood clay loam

Composition

Spottswood and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 20 to 100 acres

Typical Profile

Surface layer:
0 to 6 inches—dark gray clay loam

Subsoil:
6 to 16 inches—dark gray loam
16 to 20 inches—dark grayish brown, calcareous loam
20 to 29 inches—light brownish gray, mottled, calcareous loam

Underlying layer:
29 to 47 inches—grayish brown and light brownish gray, mottled, calcareous gravelly loamy sand
47 to 60 inches—light brownish gray, mottled, calcareous gravelly sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: 20 to 40 inches over gravelly material
Depth to the water table: 3 to 5 feet
Flooding: None
Ponding: None
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Available water capacity: Moderate
Organic matter content: High
Surface runoff: Slow

Inclusions

Contrasting inclusions:
• The poorly drained Lowe soils, which do not have gravelly material within a depth of 40 inches; on low flood plains
• The somewhat poorly drained Divide soils, which are calcareous at or near the surface; on foot slopes
• The well drained Fordville soils on summits

Similar inclusions:
• Soils that are poorly drained

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Moderate available water capacity
Management measures:
• This soil is better suited to early maturing crops, such as small grain, than to other crops.
• Minimizing tillage and leaving crop residue on the surface conserve moisture.
• Rotations that include grasses and legumes help to control erosion and maintain tilth and the content of organic matter.
• Irrigation helps to overcome the limited available water capacity if water is of adequate quantity and quality.

Interpretive Groups

Land capability classification: IIs-3
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: K

Figure 11.—A submerged roadway in an area of Southam silty clay loam.

Sy—Stickney-Dudley silt loams

Composition

Stickney and similar soils: 50 to 60 percent
Dudley and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Stickney—summits and back slopes; Dudley—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 200 acres

Typical Profile

Stickney

Surface layer:
0 to 6 inches—dark gray silt loam

Subsurface layer:
6 to 9 inches—gray silt loam
Transitional layer:
9 to 11 inches—dark gray and gray silty clay loam
Subsoil:
11 to 20 inches—dark gray silty clay loam
20 to 30 inches—very dark gray silty clay
30 to 34 inches—pale yellow, mottled, calcareous clay loam that has masses of salt
34 to 40 inches—light yellowish brown, mottled, calcareous clay loam
Underlying layer:
40 to 60 inches—light brownish gray, mottled, calcareous clay loam

Dudley

Surface layer:
0 to 8 inches—dark gray silt loam
Subsurface layer:
8 to 11 inches—gray silt loam
Subsoil:
11 to 28 inches—dark gray clay
28 to 34 inches—very dark gray clay that has nests of salt
34 to 42 inches—light brownish gray, calcareous silty clay that has nests of gypsum and other salts
42 to 50 inches—light yellowish brown, mottled, calcareous clay loam
Underlying layer:
50 to 60 inches—olive gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Stickney—slow; Dudley—very slow
Available water capacity: High
Organic matter content: Moderate
Surface runoff: Slow
Other properties: These soils have a sodium-affected subsoil.

Inclusions

Contrasting inclusions:
• The poorly drained Hoven soils in basins
• Beadle and Houdek soils, which do not have a sodium-affected subsoil; on summits and back slopes

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Fairly well suited
Management concerns: A slow rate of water infiltration and the sodium-affected subsoil, which adversely affects plant growth by restricting root penetration
Management measures:
• Leaving crop residue on the surface, minimizing tillage, tilling in a timely manner, and including grasses and legumes in the cropping system conserve moisture and maintain tilth and the content of organic matter.
• Chiseling or subsoiling when the soil is dry increases the rate of water infiltration.

Interpretive Groups

Land capability classification: Stickney—IIIs-1; Dudley—IVs-2
Range site: Stickney—Clayey; Dudley—Claypan
Windbreak suitability group: Stickney—4; Dudley—9
Pasture suitability group: Stickney—E; Dudley—C

Te—Tetonka silt loam

Composition

Tetonka and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Basins
Slope range: 0 to 1 percent
Shape of areas: Oval
Size of areas: 5 to 20 acres

Typical Profile

Surface layer:
0 to 7 inches—gray silt loam
Subsurface layer:
7 to 12 inches—gray, mottled silt loam
Subsoil:
12 to 33 inches—dark gray silty clay
33 to 44 inches—light brownish gray, mottled, calcareous clay loam
Underlying layer:
44 to 60 inches—light brownish gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches

Seasonal high water table: 1 foot above to 1 foot below the surface
Flooding: None
Ponding: Frequent for long periods
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Negligible

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Crossplain soils on toe slopes
• The very poorly drained Worthing soils in the deeper parts of basins

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Corn, oats, soybeans, spring wheat, sunflowers, and winter wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness
Management measures:
• In most years this soil is better suited to late planted crops than to other crops.
• Deferring tillage when the soil is wet helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-1
Range site: Wet Meadow
Windbreak suitability group: 10
Pasture suitability group: B2

To—Tonka silty clay loam

Composition

Tonka and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Basins
Slope range: 0 to 1 percent
Shape of areas: Oval
Size of areas: 5 to 20 acres

Typical Profile

Surface layer:
0 to 14 inches—dark gray silty clay loam

Subsurface layer:
14 to 24 inches—gray, mottled silt loam

Subsoil:
24 to 46 inches—dark gray, mottled silty clay loam
46 to 53 inches—grayish brown, mottled silty clay loam

Underlying layer:
53 to 60 inches—light brownish gray, mottled silty clay loam

Soil Properties and Qualities

Drainage class: Poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: 0.5 foot above to 1.0 foot below the surface
Flooding: None
Ponding: Frequent for long periods
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Negligible

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Badger soils around the outer edges of some basins
• The somewhat poorly drained Cubden soils on foot slopes
• The very poorly drained Parnell soils in the center of some basins

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Corn, oats, soybeans, spring wheat, and sunflowers
Suitability for cropland: Poorly suited
Management concerns: Wetness
Management measures:
• In most years this soil is better suited to late planted crops than to other crops.
• Deferring tillage when the soil is wet helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: IVw-2
Range site: Wet Meadow
Windbreak suitability group: 10
Pasture suitability group: B2

Va—Vallers-Hamerly loams

Composition

Vallers and similar soils: 50 to 60 percent
Hamerly and similar soils: 30 to 40 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Vallers—toe slopes; Hamerly—foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 80 acres

Typical Profile

Vallers

Surface layer:
0 to 6 inches—very dark gray, calcareous loam
Subsurface layer:
6 to 11 inches—dark gray, calcareous clay loam
Subsoil:
11 to 18 inches—light brownish gray, mottled, calcareous clay loam
18 to 34 inches—gray, mottled, calcareous clay loam
Underlying layer:
34 to 45 inches—gray, mottled, calcareous clay loam
45 to 60 inches—light brownish gray, mottled, calcareous clay loam

Hamerly

Surface layer:
0 to 6 inches—very dark gray, calcareous loam
Subsurface layer:
6 to 10 inches—very dark gray, calcareous loam
Subsoil:
10 to 20 inches—light brownish gray, calcareous loam
20 to 27 inches—light gray, mottled, calcareous loam
Underlying layer:
27 to 60 inches—pale yellow, mottled, calcareous loam

Soil Properties and Qualities

Drainage class: Vallers—poorly drained; Hamerly—somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: Vallers—0.5 foot to 1.5 feet; Hamerly—1.5 to 3.5 feet
Flooding: Vallers—rare; Hamerly—none
Ponding: None
Permeability: Moderately slow
Available water capacity: High
Organic matter content: High
Surface runoff: Vallers—very slow; Hamerly—slow
Other properties: Both soils have a high content of lime.

Inclusions

Contrasting inclusions:
• The moderately well drained Aastad soils on foot slopes
• Divide soils, which have gravelly material at a depth of 20 to 40 inches; on foot slopes
• The very poorly drained Parnell soils in basins
Similar inclusions:
• Soils that have more silt and less sand
• Soils that are less calcareous in the surface layer than the Hamerly soil

Use and Management

Dominant land use: Cropland and pasture
Other land use: Rangeland

Cropland

Main crops: Barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Poorly suited
Management concerns: Wetness, wind erosion, and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• In most years these soils are better suited to late planted crops than to other crops.
• Leaving crop residue on the surface and deferring tillage when the soil is wet maintain tilth, help to prevent surface compaction, and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Seeding cultivated areas to adapted grasses helps to control erosion.

Interpretive Groups

Land capability classification: Vallers—IVw-3; Hamerly—IIs-4
Range site: Vallers—Subirrigated; Hamerly—Limy Subirrigated
Windbreak suitability group: Vallers—10; Hamerly—1
Pasture suitability group: Vallers—A; Hamerly—A

Wa—Waubay silty clay loam

Composition

Waubay and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Foot slopes
Slope range: 0 to 2 percent

Shape of areas: Long and narrow
Size of areas: 10 to 30 acres

Typical Profile

Surface soil:
0 to 12 inches—very dark gray silty clay loam

Subsoil:
12 to 17 inches—dark gray silty clay loam
17 to 23 inches—brown silty clay loam
23 to 39 inches—light yellowish brown, calcareous silt loam

Underlying layer:
39 to 60 inches—light gray and grayish brown, mottled, calcareous silt loam

Soil Properties and Qualities

Drainage class: Moderately well drained
Depth to bedrock: Very deep
Depth to contrasting layer: 40 to more than 60 inches over loamy glacial till
Depth to the water table: 3.5 to 5.0 feet
Flooding: None
Ponding: None
Permeability: Moderate
Available water capacity: High
Organic matter content: High
Surface runoff: Slow
Other properties: Runoff water flows over this soil during periods of rainfall or snowmelt.

Inclusions

Contrasting inclusions:
• The somewhat poorly drained Badger soils on toe slopes
• Cubden soils, which are calcareous at or near the surface; on foot slopes
• The well drained Poinsett soils on summits and back slopes
• The poorly drained Tonka soils in basins

Similar inclusions:
• Soils that have more sand and less silt throughout

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Limitations: Slight
Management measures:
• Managing crop residue conserves moisture and helps to maintain tilth and the content of organic matter.

Interpretive Groups

Land capability classification: I-3
Range site: Loamy Overflow
Windbreak suitability group: 1
Pasture suitability group: K

Wg—Worthing silty clay loam

Composition

Worthing and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Till plains
Position on the landform: Basins
Slope range: 0 to 1 percent
Shape of areas: Oval
Size of areas: 5 to 20 acres

Typical Profile

Surface layer:
0 to 6 inches—very dark gray silty clay loam

Subsurface layer:
6 to 20 inches—dark gray silty clay loam

Subsoil:
20 to 40 inches—dark gray silty clay
40 to 49 inches—dark gray, calcareous clay
49 to 54 inches—gray, calcareous clay

Underlying layer:
54 to 60 inches—light gray, mottled, calcareous clay loam

Soil Properties and Qualities

Drainage class: Very poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: 2 feet above to 1 foot below the surface
Flooding: None
Ponding: Frequent for very long periods
Permeability: Slow
Available water capacity: High
Organic matter content: High
Surface runoff: Negligible

Inclusions

Contrasting inclusions:
• The poorly drained Tetonka soils around the outer edges of basins

Similar inclusions:
• Soils that are ponded for longer periods of time

Use and Management

Dominant land use: Rangeland

Other land use: Pasture

Cropland

Suitability for cropland: Very poorly suited

Rangeland

Management concerns: Wetness
Management measures:
• Proper grazing management maintains plant vigor.
• Restricting grazing during wet periods helps to prevent surface compaction.
• Maintenance of existing drainage systems is needed to remove excess water.

Interpretive Groups

Land capability classification: Vw-4
Range site: Shallow Marsh
Windbreak suitability group: 10
Pasture suitability group: B2

Wm—Wyndmere fine sandy loam

Composition

Wyndmere and similar soils: 85 to 95 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Foot slopes
Slope range: 0 to 2 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 7 inches—dark gray, calcareous fine sandy loam
Subsoil:
7 to 14 inches—gray, calcareous fine sandy loam
14 to 28 inches—light brownish gray, calcareous fine sandy loam
Underlying layer:
28 to 46 inches—light yellowish brown, mottled, calcareous loamy fine sand
46 to 60 inches—light yellowish brown, mottled, calcareous loamy very fine sand

Soil Properties and Qualities

Drainage class: Somewhat poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Depth to the water table: 1.5 to 3.5 feet
Flooding: None
Ponding: None
Permeability: Moderately rapid
Available water capacity: Moderate
Organic matter content: Moderate
Surface runoff: Slow
Other properties: This soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The poorly drained Oldham and very poorly drained Parnell soils in basins
• The moderately well drained Embden soils on the upper foot slopes
Similar inclusions:
• Soils that have more clay and less sand

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Alfalfa, barley, corn, oats, soybeans, and spring wheat
Suitability for cropland: Well suited
Management concerns: Wind erosion and the high content of lime, which adversely affects the availability of plant nutrients
Management measures:
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Wind stripcropping and field windbreaks help to control wind erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.

Interpretive Groups

Land capability classification: IIs-4
Range site: Limy Subirrigated
Windbreak suitability group: 1
Pasture suitability group: H

Wp—Wyndmere-Parnell complex

Composition

Wyndmere and similar soils: 50 to 65 percent
Parnell and similar soils: 20 to 35 percent
Contrasting inclusions: 5 to 15 percent

Setting

Landform: Outwash plains
Position on the landform: Wyndmere—toe slopes; Parnell—basins
Slope range: Wyndmere—0 to 3 percent; Parnell—0 to 1 percent
Shape of areas: Irregular
Size of areas: 10 to 100 acres

Typical Profile

Wyndmere

Surface layer:
0 to 7 inches—dark gray, calcareous fine sandy loam

Subsoil:
7 to 14 inches—gray, calcareous fine sandy loam
14 to 28 inches—light brownish gray, calcareous fine sandy loam

Underlying layer:
28 to 46 inches—light yellowish brown, mottled, calcareous loamy fine sand
46 to 60 inches—light yellowish brown, mottled, calcareous loamy very fine sand

Parnell

Surface soil:
0 to 16 inches—very dark gray silty clay loam

Subsoil:
16 to 23 inches—dark gray, mottled silty clay loam
23 to 44 inches—dark gray, mottled silty clay

Underlying layer:
44 to 60 inches—gray, mottled, calcareous silty clay

Soil Properties and Qualities

Drainage class: Wyndmere—somewhat poorly drained; Parnell—very poorly drained
Depth to bedrock: Very deep
Depth to contrasting layer: Greater than 60 inches
Seasonal high water table: Wyndmere—at a depth of 1.5 to 3.5 feet; Parnell—1.0 foot above to 0.5 foot below the surface
Flooding: None
Ponding: Wyndmere—none; Parnell—frequent for very long periods
Permeability: Wyndmere—moderately rapid; Parnell—slow
Available water capacity: Wyndmere—moderate; Parnell—high
Organic matter content: Wyndmere—moderate; Parnell—high
Surface runoff: Wyndmere—slow; Parnell—negligible
Other properties: The Wyndmere soil has a high content of lime.

Inclusions

Contrasting inclusions:
• The poorly drained Oldham and Tonka soils in shallow basins
• The moderately well drained Embden soils on the upper foot slopes

Similar inclusions:
• Soils that have more clay and less sand than the Wyndmere soil
• Soils that have more clay throughout than the Wyndmere soil

Use and Management

Dominant land use: Cropland
Other land use: Pasture and hayland

Cropland

Main crops: Wyndmere—alfalfa, barley, corn, oats, and spring wheat; Parnell—unsuited
Suitability for cropland: Well suited
Management concerns: Wyndmere—wind erosion and the high content of lime, which adversely affects the availability of plant nutrients; Parnell—wetness
Management measures:
• Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control erosion.
• Rotations that include grasses and legumes help to control erosion and maintain organic matter content, fertility, and tilth.
• Maintenance of existing drainage systems is needed to remove excess water on the Parnell soil.
• Deferring tillage and restricting grazing during wet periods help to prevent surface compaction on the Parnell soil.

Interpretive Groups

Land capability classification: Wyndmere—IIs-4; Parnell—Vw-2
Range site: Wyndmere—Limy Subirrigated; Parnell—Shallow Marsh
Windbreak suitability group: Wyndmere—1; Parnell—10
Pasture suitability group: Wyndmere—H; Parnell—B2

Prime Farmland

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

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

with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

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

About 334,000 acres in the survey area, or nearly 54 percent of the total acreage, meets the soil requirements for prime farmland. This land is throughout the county. Almost all of the prime farmland is used for crops, mainly corn, oats, barley, alfalfa, soybeans, sunflowers, potatoes, spring wheat, and winter wheat.

The map units in the survey area that are considered prime farmland are listed in table 5. 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. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that have limitations, such as a seasonal high water table or inadequate rainfall, qualify for prime farmland only in areas where these limitations have been overcome by such measures as drainage or irrigation. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

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 to prevent 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 behavioral 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 and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

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

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

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

The soils in the survey area are assigned to various interpretive groups at the end of each map unit description. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops

Dennis Shoup, conservation agronomist, Natural Resources Conservation Service, helped prepare this section.

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

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

About 65 percent of the acreage in Clark County is used for cultivated crops (USDA, 1987). The major crops are wheat, corn, alfalfa, soybeans, oats, and barley. Potatoes, sunflowers, flax, sorghum, and rye are also grown. Corn and oats are grown as a cash crop and as livestock feed, and alfalfa is harvested mainly for hay.

The potential of the soils in Clark County for increased crop production is good. Crop production could be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology. The paragraphs that follow describe the management needed on the cropland in the county.

Water erosion reduces productivity and results in sedimentation. It is a hazard on Forman, Kranzburg, Poinsett, and other soils if the slope is more than 2 percent. Productivity is reduced when the more fertile surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a thin surface layer, such as Buse, Ethan, and Rusklyn soils. Erosion also reduces the productivity of soils that tend to be droughty, such as Egeland and Renshaw soils.

When erosion occurs, sediment that is rich in nutrients and possibly in herbicides enters streams, lakes, and reservoirs. Measures that control erosion minimize this pollution and preserve the quality of water for fish and other wildlife and for recreational uses. They also reduce the amount of fertilizer needed in cropped areas by helping to prevent the removal of plant nutrients and pesticides. A conservation cropping system that keeps a plant cover on the surface for extended periods holds soil losses to an amount that does not reduce the productive capacity of the soils. If maintaining a cover of vegetation is not possible, careful management of crop residue is essential. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration, reduce the runoff rate, and help to control erosion.

Conservation tillage includes tillage systems that do not invert the soil and that retain a protective cover of crop residue on the surface throughout the year. It is effective in controlling wind erosion and water erosion. Conservation tillage includes no-till, strip-till, ridge-till, stubble mulching, and chemical fallow systems that involve a minimum number of tillage operations. Stubble is left standing during the winter. It traps and holds snow on the field; when the snow melts, more water is allowed to infiltrate into the soil.

Terraces and diversions reduce the runoff rate and help to control erosion by reducing the length of slopes. These measures are most practical on very deep, well drained soils that have long, smooth slopes, such as Poinsett soils. Many of the soils in Clark County, however, are poorly suited to terraces and diversions because the slopes are short and irregular. Grassed waterways are effective in controlling gully erosion.

Wind erosion is a slight to severe hazard on many of the soils in the county. The hazard is greatest on soils that have a surface layer of sandy loam, such as Egeland and Maddock soils. Soils that have a high content of lime in the surface layer, such as Buse, Ethan, Cubden, and Hamerly soils, are also susceptible to wind erosion. These soils can be damaged in a few hours if winds are strong and the soils are dry and are not protected by a plant cover or surface mulch. Wind erosion can be controlled by an adequate plant cover, a cover of crop residue, stripcropping, and tillage methods that keep the surface rough. Planting windbreaks of suitable trees and shrubs and leaving strips of unharvested crops also are effective in controlling wind erosion.

Information about measures that control erosion on each kind of soil is provided in the Technical Guide, which is available in the local office of the Natural Resources Conservation Service.

Wetness is a major limitation on some soils in the county, including the very poorly drained Oldham soils, the poorly drained Tonka soils, and the somewhat poorly drained Badger and Crossplain soils. In areas that are not drained, these soils are so wet that crops frequently are damaged. Keeping established ditches open helps to remove excess surface water if drainage outlets are available. Controlling the runoff from adjacent slopes also reduces the wetness of these soils. In some years, crops may not be affected and these soils may be more productive than the drier upland soils.

The moderately well drained Aastad, Svea, and Waubay soils are on foot slopes that receive runoff from adjacent uplands. In most years, drainage is adequate and crops benefit from the additional moisture. A drainage system is rarely beneficial on these soils. During wet years, however, the wetness delays spring planting and tillage.

Soil fertility helps to determine the yields that can be obtained from the soil. The kinds and amounts of fertilizer needed on Buse, Cubden, Ethan, Hamerly, and other soils that have a high content of lime in the surface layer generally differ from those needed on other soils. A nutrient management plan should be based on the type of soil, the amount of available moisture, the kind of crop to be planted, realistic yield goals, and current soil fertility test levels. Other considerations include whether or not legumes have been planted in either of the last 2 years, whether or not agricultural waste has been applied, and the likelihood that surface water or ground water will be polluted by nutrients. The plan should be developed annually and should provide for the amount of each nutrient needed, the preferred method of application, and the preferred time of application. The Natural Resources Conservation Service, the South Dakota Cooperative Extension Service, or the South Dakota Agricultural Experiment Station can help in developing a nutrient management plan.

Soil tilth is an important factor in the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous. Management can influence the tilth of a specific soil. Management measures that promote good tilth generally result in an increased rate of water infiltration and a higher water-holding capacity and thus provide a better environment for seedling emergence and root development. These positive effects increase crop yields. Improving soil tilth also reduces the amount of horsepower required for tillage.

Surface compaction is also an important factor in soil management. It can result when important physical properties of the soil, such as pore space, are degraded. When compaction occurs in the surface layer

or subsoil, aeration is impaired and plant roots have more difficulty pushing through the soil to reach water. Other soil conditions that affect compaction are wet conditions and clayey textures in the surface layer and subsoil.

Management measures that improve soil tilth and minimize surface compaction include using high-residue crops in rotation a high percentage of the time, preventing trampling by livestock during wet periods, deferring the use of equipment during wet periods, leaving as much residue as possible on or near the surface, and eliminating unnecessary tillage trips. The timing of farming activities is critical. If compaction has occurred, it can be reduced by ripping or deep plowing. Tilth and compaction are especially important on clayey soils, such as Beadle, Peever, and Sinai soils, and on soils that have a claypan or a sodium-affected subsoil, such as Cavour, Cresbard, Dudley, Jerauld, and Stickney soils.

Sodium-affected soils have a slow rate of water infiltration. They are less productive than other soils because they have a lower content of organic matter and because the dense layer in the subsoil restricts the penetration of roots and moisture. Tilth and compaction are also concerns. Management of sodium-affected soils should always include tilling in a timely manner, minimizing tillage, and leaving crop residue on the surface. Rotations that include grasses and legumes help to maintain fertility, tilth, and the content of organic matter. Chiseling and subsoiling when the soil is dry increase the rate of water infiltration.

Field crops suited to the soils and climate of the area include small grain and row crops. Wheat, barley, and oats are the main small grain crops. Corn, soybeans, and sunflowers are the main row crops. Potatoes are an important specialty crop.

The very deep, well drained and moderately well drained soils in Clark County are suited to all of the commonly grown crops. Examples are Aastad, Forman, Kranzburg, Poinsett, Svea, and Waubay soils. In areas of the erosive Egeland and Maddock soils, high-residue crops, such as small grain and alfalfa, are suitable for planting. With proper management, these crops produce enough residue to protect the field from wind erosion. Soils that have a high content of sodium, such as Cavour and Dudley soils, and soils that have a high content of salt, such as Playmoor and Salmo soils, may be better suited to small grain crops, such as barley, than to deep-rooted row crops, such as corn. If low-residue crops, such as sunflowers, are planted or a summer fallow system is used, field windbreaks, no-till farming, or other conservation practices may be needed to reduce the hazard of wind erosion. Soils that are underlain by porous material, such as Fordville and Renshaw soils, are better suited to early maturing small grain than to deeper rooted crops, such as corn and alfalfa, because the porous underlying material restricts the available water capacity and hinders root development.

Pasture and Hayland

David W. Schmidt, range conservationist, Natural Resources Conservation Service, helped prepare this section.

Pasture and hayland are used for the production of adapted domesticated perennial forage plants to be grazed by livestock or harvested for hay. These forage plants may be either native or introduced species and may be seeded alone or in mixtures. Generally, these species are established as part of a long-term forage program, but in some areas legumes or grasses have been established as part of a short-term crop rotation.

About 8 percent of the county is classified as pasture and hayland (USDA, 1987). This acreage supplies a major portion of the forage for livestock. It includes areas that formerly supported native vegetation but have been invaded by introduced tame grasses, such as smooth bromegrass, because of overgrazing. Managing these sites as native rangeland is no longer practical in many cases. Because of overgrazing, improper management, and poor agronomic practices, much of the pasture or hayland is presently producing well below its potential.

Proper management of pasture and hayland is needed to obtain sustained maximum yields. Proper stocking rates allow the pasture plants to retain their vigor. Overgrazing results in depletion of the root systems of the pasture plants. If continued overgrazing is allowed, the plants will eventually die out and be replaced by less desirable species and weeds. A planned grazing system that includes periods of adequate rest or deferment for the key pasture species improves plant vigor and thus improves production. Including rest periods between periods of grazing allows the pasture plants to regrow and replenish their energy reserves. Harvesting hay crops at the proper stage of plant growth also helps to maintain plant vigor. Generally, the plants should be allowed to grow to early or mid bloom stage before they are harvested. Grazing pasture species at the proper stage of growth also increases production. The plants should not be grazed before they have produced enough leaf material to replenish stored energy reserves. Generally, the plants should be allowed to grow to a height of 8 to 14 inches before grazing is allowed. The proper height depends on the species being managed. If the plants become too tall or mature before grazing is allowed, the quality and quantity of the forage can be affected. Also,

allowing the plants to regrow before the first killing frost provides adequate energy reserves for survival through the winter and for the initiation of regrowth in the spring. Allowing regrowth also increases the ability of the plants to trap snow, thereby increasing soil moisture.

Pasture and hayland species can be divided into two broad categories. Cool-season species begin their growth in the early spring and reach maturity in early summer. If soil moisture is adequate, they may regrow in the fall when temperatures cool. Warm-season species begin growth in the early summer. They produce most of their forage during the hot summer months. Cool-season plants include smooth bromegrass, intermediate wheatgrass, and alfalfa. Warm-season species include big bluestem and switchgrass. Selecting a warm-season species will ensure a productive, nutritious forage source for livestock during July and August. Using a cool-season species during this same period would produce less forage.

Proper management includes the periodic reestablishment of pasture and hayland. The length of time that pasture and hayland remain productive depends on the plant species, the type of soil, climatic factors, and management techniques. Generally, many of the tame species should be replaced every 5 to 10 years. Native species that are adapted to the site generally remain productive for an extended period of time, depending on the kind of management applied. Species selection should be based on the type of soil and on producer needs. Using improved varieties can result in increased production, improved forage quality, and improved establishment and longevity of the stands.

Maintaining soil fertility is an important management concern. Applications of fertilizer should be based on the results of soil tests. Care should be taken to prevent the contamination of water supplies. Proper levels of fertilizer can increase production, increase the longevity of the stand, and improve the quality of forage. Planting legumes, such as alfalfa, in combination with grasses increases the nitrogen level and thus helps to meet the nutrient needs of grass species.

Weeds can be a problem if proper management techniques are not applied. Allowing overgrazing, selecting species that are not adapted to the site, and failing to maintain soil fertility can increase the extent of weeds in areas of pasture and hayland.

At the end of each map unit description and in the section "Interpretive Groups," the soil has been assigned to a pasture suitability group. These groups are based primarily on the suitability of the soil for certain pasture or hayland species, management needs, and potential productivity. The principal criteria for assigning a soil to a pasture suitability group include depth, drainage class, texture, structure, permeability, available water capacity, landscape position, and special internal features. Detailed interpretations for each pasture suitability group in the county are provided in the Technical Guide, which is available in the local office of the Natural Resources Conservation Service. General descriptions of the pasture suitability groups in this county are provided in the following paragraphs. The descriptions include limitations affecting the use of the soils for pasture or hayland and a list of suitable plant species. The species are selected based on yield potential, adaptability to the site, palatability, and relative ease of establishment.

Group A.—The soils in this group receive additional moisture from runoff or flooding. All climatically adapted grasses and legumes are suitable, but only plants that are capable of utilizing the extra moisture are recommended.

The soils in this group are artificially drained or have a water table that is seasonally high for only short periods. Examples are Badger, Crossplain, Lowe, Mauvais, Minnewaukan, Ranslo, and Vallers soils. The species that are most suitable in areas of these soils include alfalfa, big bluestem, creeping foxtail, indiangrass, intermediate wheatgrass, reed canarygrass, smooth bromegrass, orchardgrass, and switchgrass. Maintaining plant vigor is the major management concern. Proper grazing use, including deferred grazing and timely harvesting, helps to maintain plant vigor. Applications of fertilizer may also be needed. Surface compaction may be a concern during wet periods. Deferring use during these periods helps to minimize compaction.

Group B1.—The soils in this group receive additional moisture from runoff or flooding. Because of the excess moisture, the selection of climatically adapted grasses is limited to water-tolerant species.

The soils in this group are not artificially drained and do not have a water table that is seasonally high for prolonged periods. Examples are Colvin, Marysland, Oldham, and Rauville soils. The species that are most suitable in areas of these soils include creeping foxtail and reed canarygrass. The main management concern is surface compaction, which can result from harvesting or grazing during periods when the soils are saturated. Deferring grazing or haying during these periods can minimize compaction and improve plant vigor.

Group B2.—The soils in this group receive additional moisture from runoff. Because of the excess moisture, the selection of climatically adapted grasses is limited to water-tolerant species.

The soils in this group are subject to ponding and are not artificially drained. Examples are Heil, Hoven,

Parnell, Tetonka, Tonka, and Worthing soils. The species that are most suitable in areas of these soils include creeping foxtail and reed canarygrass. The major management concerns are saturated soil conditions and the accumulation of salts in some soils, which can increase the risk of surface compaction. Deferring grazing or haying during wet periods can minimize compaction and improve plant vigor.

Group C.—The soils in this group have a claypan subsoil and typically have a high content of soluble salts in the lower part of the subsoil and in the underlying material. The unfavorable root zone limits the selection and productivity of climatically adapted grasses and legumes.

Cavour, Dudley, and Farmsworth soils are in this group. The species that are most suitable in areas of these soils include alfalfa, crested wheatgrass, green needlegrass, intermediate wheatgrass, pubescent wheatgrass, smooth bromegrass, and western wheatgrass. The major management concerns are the accumulation of excess salts, the risk of surface compaction, and the slow rate of water infiltration. Proper grazing use, deferred grazing, and proper hayland management are needed to maintain a healthy plant community. Additions of fertilizer may also be needed.

Group D1.—The soils in this group have a moderately deep root zone and a limited available water capacity, which restrict the selection of climatically adapted grasses and legumes.

The soils in this group are excessively drained to somewhat poorly drained and are moderately deep over sand and gravel. The somewhat poorly drained soils and some of the moderately well drained soils have a water table that is seasonally high for short periods and are calcareous at or near the surface. Typical soils in this group include Divide, Enet, and Fordville soils. The species that are most suitable in areas of these soils include alfalfa, intermediate wheatgrass, and smooth bromegrass. The major management concerns are overcoming droughtiness, which is caused by the limited available water capacity, and maintaining plant vigor. Applications of fertilizer may also be needed. When nutrients or pesticides are applied, measures that protect ground water from pollution are needed. Proper hayland management and proper grazing use, including deferred grazing or a planned grazing system, help to maintain plant vigor.

Group D2.—The soils in this group have a shallow root zone and a very low available water capacity, which limit the selection of climatically adapted grasses.

The soils in this group are excessively drained to moderately well drained and are shallow over sand and gravel. Delmont and Renshaw soils are examples. The species that are most suitable in areas of these soils include crested wheatgrass and pubescent wheatgrass. Maintaining the plant community can be difficult because of the extreme droughtiness and the shallow root zone. Proper grazing use, deferred grazing, a planned grazing system, and timely harvesting help to maintain plant vigor. If nutrients or pesticides are applied, measures that protect ground water from pollution are needed.

Group E.—The soils in this group generally contain a high content of soluble salts in the underlying material. The unfavorable root zone limits the selection and productivity of climatically adapted grasses and legumes.

Beadle, Cresbard, Peever, and Stickney soils are in this group. The species that are most suitable in areas of these soils include alfalfa, big bluestem, green needlegrass, indiangrass, intermediate wheatgrass, smooth bromegrass, and switchgrass. The major management concerns are maintaining plant vigor and maintaining tilth. Proper grazing use, deferred grazing, a planned grazing system, and proper hayland management improve plant vigor and help to maintain tilth. Applications of fertilizer may also be needed.

Group F.—The soils in this group are suited to all climatically adapted grasses and legumes, but bunch-type grass species are not recommended in areas where the slope is 6 percent or more.

The soils in this group include Barnes, Clarno, Cubden, Davison, Forman, Hamerly, Hetland, Houdek, Kranzburg, and Poinsett soils. The species that are most suitable in areas of these soils include alfalfa, big bluestem, green needlegrass, indiangrass, intermediate wheatgrass, smooth bromegrass, switchgrass, and orchardgrass. The major management concerns are maintaining plant vigor and maintaining good tilth. Proper grazing use, deferred grazing, a planned grazing system, and proper hayland management improve plant vigor, help to maintain tilth, and help to prevent surface compaction. Applications of fertilizer may also be needed.

Group G.—The soils in this group are calcareous within a depth of 10 inches. They range from gently sloping to moderately steep. The selection and productivity of climatically adapted grasses and legumes are limited by the slope, the high content of lime, and the hazard of erosion.

The soils in this group include Betts, Buse, Ethan, and Rusklyn soils. The species that are most suitable in areas of these soils include alfalfa, crested wheatgrass, intermediate wheatgrass, pubescent wheatgrass, and smooth bromegrass. The major management concerns are maintaining plant vigor and controlling erosion. Proper grazing use, deferred grazing, a planned grazing

system, and proper hayland management improve plant vigor and help to control erosion. Applications of fertilizer may also be needed.

Group H.—The soils in this group are susceptible to erosion. Also, a limited available water capacity restricts the selection and productivity of climatically adapted grasses and legumes.

The soils in this group include Blendon, Egeland, Embden, Henkin, Maddock, and Wyndmere soils. The species that are most suitable in areas of these soils include alfalfa, big bluestem, indiangrass, intermediate wheatgrass, smooth bromegrass, and switchgrass. The major management concerns are maintaining plant vigor and controlling erosion. Proper grazing use, deferred grazing, a planned grazing system, and proper hayland management improve plant vigor and help to control erosion. Applications of fertilizer may also be needed. When nutrients or pesticides are applied, measures that protect ground water from pollution are needed.

Group I.—The soils in this group have an unfavorable root zone and a very slow rate of water infiltration, which limit the selection and productivity of climatically adapted grasses and legumes. The soils also have a clayey surface layer and subsoil.

Sinai soils are in this group. The species that are most suitable in areas of these soils include alfalfa, green needlegrass, intermediate wheatgrass, smooth bromegrass, switchgrass, and big bluestem. The major management concerns are maintaining plant vigor and maintaining tilth. Surface compaction is also a concern during wet periods. Proper grazing use, deferred grazing, a planned grazing system, and proper hayland management improve plant vigor and help to maintain tilth. Applications of fertilizer may also be needed.

Group J.—The soils in this group are characterized by excessive salinity and alkalinity, which severely limit the selection and productivity of climatically adapted grasses and legumes.

The soils in this group include Durrstein, Harriet, Holmquist, Ludden, Playmoor, and Salmo soils. The species that are most suitable in areas of these soils include tall wheatgrass and western wheatgrass. The major management concern is maintaining the desirable plant community. Proper grazing use, deferred grazing, a planned grazing system, and proper hayland management help to maintain plant vigor and ensure the survival of the stand.

Group K.—The soils in this group receive additional moisture from runoff. They are suited to all of the climatically adapted grasses and legumes.

The soils in this group include Aastad, Bon, Bonilla, Dimo, LaDelle, La Prairie, Prosper, Svea, and Waubay soils. The species that are most suitable in areas of these soils include alfalfa, big bluestem, creeping foxtail, indiangrass, intermediate wheatgrass, reed canarygrass, orchardgrass, smooth bromegrass, and switchgrass. The major management concerns are maintaining plant vigor and maintaining tilth. Proper grazing use, deferred grazing, a planned grazing system, and proper hayland management improve plant vigor, help to maintain tilth, and help to prevent compaction. Applications of fertilizer may also be needed.

Group NS.—The soils in this group are generally not suitable for pasture or hayland plantings because they are very shallow to gravel, are sandy and have a low content of organic matter, are very strongly saline or alkaline, are clayey and have a dense subsoil, are stony or very stony, or are subject to ponding. Examples are Ferney, Jerauld, Langhei, Sioux, and Southam soils.

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 6. 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 or ranchers, conservationists, researchers, 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 a cropping sequence that makes the best use of the available moisture; 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 other essential elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

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

Crops other than those shown in table 6 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 Natural Resources Conservation Service or of the South Dakota Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

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

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

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

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

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

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

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

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the 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.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 and IIIe-6.

The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the section "Interpretive Groups," which follows the tables at the back of this survey.

Rangeland

David W. Schmidt, range conservationist, Natural Resources Conservation Service, helped prepare this section.

Rangeland supports native vegetation suitable for grazing or browsing. It includes areas where native vegetation has been reestablished. The vegetation is mainly grasses, grasslike plants, forbs, or shrubs. The amounts and kinds of native vegetation in any one area are determined by the soil, topography, climate, past use, and management.

All of the county was rangeland before the first permanent settlers arrived. Currently, about 21 percent of the county supports native vegetation (USDA, 1987). This rangeland supplies a portion of the forage for livestock in the county. Approximately 66 percent of the farm and ranch income in the county is derived from the sale of livestock and livestock products (U.S. Department of Commerce, 1991). Most of the livestock enterprises are cow-calf operations. Some are yearling operations, and some combine cow herds with yearlings. This latter practice permits greater flexibility in adjusting livestock numbers during periods of drought. Sheep are raised in limited numbers throughout the county and are often run in combination with cow herds. The rangeland is generally grazed from May to October. The forage provided by rangeland is generally supplemented by crop aftermath and tame pasture plants, such as intermediate wheatgrass and smooth bromegrass. In winter the forage is supplemented by protein concentrate and hay.

Clark County is part of the tall grass prairie. The

native vegetation is dominated by tall and mid grasses and forbs. Common tall grass species include big bluestem, switchgrass, and prairie dropseed. Mid grasses include little bluestem, sideoats grama, and needlegrasses. Goldenrod and prairie-clover are common forbs. The tall grass prairie consists of cool- and warm-season plants, which provide good quality forage throughout the growing season. The cool-season plants grow mostly during April, May, and June and include such plants as porcupinegrass. The warm-season plants grow mostly during June, July, and August and include such plants as big bluestem. The cool-season grasses may start growing again in September and October if rainfall is adequate.

The native vegetation in many parts of the county is producing below its potential because of past management. The tall grasses and some of the mid grasses have been replaced by less desirable plants. In many areas of the county, the past misuse of the native vegetation has resulted in an invasion of cool-season tame grasses, such as smooth bromegrass and Kentucky bluegrass. As a result, the amount of available forage is reduced. In most areas, however, enough of the original plants remain for the reestablishment of high-quality native plants if good management practices are applied.

Range Sites and Condition Classes

Different kinds of soil vary in their capacity to produce native vegetation. 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. Soils that produce approximately the same kinds, amounts, and proportions of native vegetation make up a range site. The potential native vegetation on a range site is the stabilized plant community that the site is capable of producing. It consists of the plants that were growing on the site when the region was settled. This plant community maintains itself and changes very little as long as the environment remains unchanged. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil maps.

The plants within the native plant community are sometimes grouped as decreasers, increasers, and invaders, depending on their response to grazing pressure. Decreasers are plants that respond to overgrazing by decreasing in abundance. They generally are the most productive plants and the ones most preferred by the grazing animals. Increasers are plants that respond to grazing pressure, at least initially, by increasing in amount as the more desirable decreaser plants become less abundant. Increasers generally are less productive and less preferred by the grazing animals. Invaders are plants that are not part of the original plant community but invade because of some kind of disturbance or continued overgrazing. Some invader plants have little or no value for grazing.

Because plants do not respond in the same manner to different influences, a plant may be a decreaser on some range sites but an increaser on others. A cool-season plant, for example, may be a decreaser if the site is grazed only during the spring but would be an increaser if the same site were grazed only during the summer. The reverse would be true for the warm-season plants. Restricting grazing to the spring would cause the warm-season plants to increase in abundance, and restricting grazing to the summer would cause them to decrease.

Table 7 shows, for nearly all of the soils, the range site; the composition of species in the potential natural plant community; and the potential annual production of vegetation in favorable, average, and unfavorable years. *Potential annual 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 leaf, 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, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperature make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management maintains the capacity of the rangeland to produce forage for livestock and game animals and to provide wildlife habitat, water, and watershed protection. The primary objective of good range management is to keep the rangeland in excellent or good condition. The main management concern is responding to important changes in the plant community of a range site.

Range condition is determined by comparing the present vegetation on a range site with the potential native plant community for the site. Four range condition classes are recognized. The range site is in *excellent* condition if 76 to 100 percent of the present

vegetation is the same kind as the potential native vegetation. It is in *good* condition if the percentage is 51 to 75, in *fair* condition if the percentage is 26 to 50, and in *poor* condition if the percentage is 25 or less. The potential production depends on the range site, the range condition, and the moisture available to plants during the growing season.

Measures that maintain or improve the range condition are needed on all of the rangeland in the county. Such measures include proper stocking rates and rotation or deferred rotation grazing systems. These systems provide rest periods that maintain or improve the vigor of the key plants. Good range management also includes range seeding, fencing, and measures that provide water for livestock.

The soils in the county are assigned to 17 different range sites. These range sites are described in the following paragraphs.

Clayey range site. The potential native vegetation is a mixture of tall and mid grasses interspersed with a variety of forbs. Big bluestem and little bluestem, which are warm-season grasses, make up about 50 percent of the vegetation in about equal proportions. Needlegrasses and western wheatgrass are the dominant cool-season grasses. They make up about 25 percent of the vegetation. Other grasses that occur in lesser amounts include sideoats grama, blue grama, and grasslike sedges. Forbs, such as sageworts, heath aster, false boneset, and yarrow, are common but generally make up less than 10 percent of the vegetation.

The major management concern on this site is maintaining the most productive grasses. Big bluestem, little bluestem, and needlegrasses rapidly lose their productive capacity after continued overgrazing because of their palatability to livestock. If overgrazing is allowed, western wheatgrass, sideoats grama, and blue grama increase in abundance. If overgrazing continues, bluegrasses, blue grama, or both become dominant and the production of short grasses is limited. The most productive grasses can be maintained by using proper stocking rates and by using a rotation grazing or deferred grazing program, which provides rest periods during the key growing season of these plants. Restricting grazing during wet periods helps to prevent surface compaction.

Claypan range site. The potential native vegetation is a prairie of mid and tall grasses interspersed with some forbs. Western wheatgrass and green needlegrass, which are cool-season species, are codominant species. They make up about 55 percent of the vegetation. Big bluestem and switchgrass, which are warm-season species, make up approximately 15 percent of the vegetation. Blue grama and sedges are common understory grasses but occur in small amounts. Forbs, such as sageworts, heath aster, and scarlet globemallow, occur on this site but make up less than 10 percent of the vegetation.

The major management concern on this site is maintaining the most productive plants. Big bluestem, switchgrass, and green needlegrass rapidly decrease in abundance after continuous overgrazing because of their palatability to livestock. Western wheatgrass initially increases in abundance, but if overgrazing continues this species is replaced by short grasses, such as blue grama, bluegrasses, or both. The most productive grasses can be maintained by using proper stocking rates and by using a rotation grazing or deferred grazing program, which provides rest periods during the key growing season of these plants. Restricting grazing during wet periods helps to prevent surface compaction.

Closed Depression range site. The potential native vegetation is dominated by western wheatgrass, which makes up about 70 percent of the vegetation, and by sedges, which make up about 10 percent. The plant community is not stable, however, because of alternating wetness and drying. Because this site is on flat or concave bottoms of closed depressions, it is excessively wet or ponded during wet periods and can be droughty during abnormally dry periods.

The major management concern on this site is maintaining the most desirable plant community. If continued overgrazing is allowed, the extent of western wheatgrass is reduced and that of short grasses, such as saltgrass and Kentucky bluegrass, increases. Also, trampling by livestock hinders natural drainage. The most productive grasses can be maintained by using proper stocking rates and by using a rotation grazing or deferred grazing system, which provides rest periods during the key growing season of the desired plants and during the wet periods. Surface compaction is a potential problem during wet periods. Deferred grazing helps to minimize compaction and improves plant vigor.

Limy Subirrigated range site. The potential native vegetation on this site is an excellent stand of warm-season, tall and mid grasses. Big bluestem and little bluestem, which are warm-season grasses, make up about 60 percent of the vegetation. Cool-season needlegrasses make up about 20 percent of the vegetation. Blue grama, bluegrasses, and sedges are in the understory. Forbs are common but are not dominant. This site is less productive than the Subirrigated site because of the seasonal high water

table and the high content of lime in the soils.

The major management concern on this site is maintaining the extent of the most productive grasses. Big bluestem loses its productive capacity and thins out after continuous grazing because it is preferred by livestock. As the extent of big bluestem decreases, the extent of little bluestem and sideoats grama initially increases. After continuous overgrazing, however, bluegrasses, sedges, and downy brome become the principal plants on the site. Low forage production is the result. The extent of the most productive grasses can be increased or maintained by using proper stocking rates and by using a deferred grazing or rotation grazing program, which provides rest periods during the key growing season of the desirable plants.

Loamy Overflow range site. The potential native vegetation on this site is tall, warm-season prairie grasses. Big bluestem makes up about 60 percent of the vegetation. Warm-season, mid grasses, such as little bluestem and sideoats grama, make up about 10 percent. Sedges and bluegrasses are in the understory. Forbs, such as Maximilian sunflower, stiff sunflower, tall gayfeather, and goldenrod, and shrubs, such as leadplant and wild rose, occur on the site but are not dominant.

The major management concern on this site is maintaining the extent of the most productive grasses and forbs. Big bluestem, switchgrass, Maximilian sunflower, and stiff sunflower lose their productive capacity and thin out after continuous grazing because the livestock prefer these plants. As the extent of these plants decreases, the extent of little bluestem and sideoats grama initially increases. After continuous overgrazing, however, bluegrass, which is a short, cool-season grass, becomes the principal plant on the site. Low forage production is the result. The extent of the most productive grasses can be increased or maintained by using proper stocking rates and by using a deferred grazing or rotation grazing program, which provides rest periods during the key growing season of these plants.

Saline Lowland range site. The climax plant cover on this site is made up of species that are tolerant of saline conditions. Cordgrasses commonly are dominant and may make up as much as 55 percent of the vegetation. Nuttall alkaligrass, switchgrass, western wheatgrass, alkali muhly, and foxtail barley are also common. Saltgrass is the most abundant short grass. The grasses typically are not dominant but make up a rather small percentage of the vegetation on this site. Sedges and forbs, such as seepweed and glasswort, occur in small amounts. Woody plants are rare. The soils on this site generally have a seasonal high water table within a depth of 1 to 4 feet. Some small areas that are included with this site do not have a water table high enough to support cordgrasses.

The major management concern on this site is maintaining the extent of the most productive grasses. Cordgrass and Nuttall alkaligrass rapidly lose vigor and density if continued overgrazing is allowed. As the extent of these species decreases, saltgrass becomes the principal grass species on the site. Low forage production is the result. The extent of the most productive grasses can be maintained by using proper stocking rates and by using a rotation grazing or deferred grazing program, which provides rest periods during the key growing season of the plants. Surface compaction is a potential problem during wet periods. Deferred grazing helps to prevent compaction and improves plant vigor.

Saline Subirrigated range site. The potential native vegetation on this site is an excellent stand of warm-season, tall and mid grasses. Little bluestem makes up about 45 percent of the vegetation. Big bluestem makes up 20 percent; indiangrass, 10 percent; switchgrass, 10 percent; and sedges and forbs, 10 percent.

The major management concern on this site is maintaining the extent of the most productive plants. The plant community is very fragile. Big bluestem, little bluestem, indiangrass, and switchgrass rapidly lose their productive capacity and thin out after continuous grazing because livestock prefer these plants. As the extent of these plants decreases, inland saltgrass and foxtail barley become the principal plants on the site. Low forage production is the result. The extent of the most productive grasses can be increased or maintained by using proper stocking rates and by using a deferred grazing or rotation grazing program, which provides rest periods during the key growing season of the desirable plants. Surface compaction is a potential problem during wet periods. Deferred grazing helps to prevent compaction and improves plant vigor.

Sandy range site. The potential native vegetation on this site is dominated by tall and mid, warm-season grasses. Big bluestem, sand bluestem, or both and prairie sandreed make up about 45 percent of the vegetation. Sideoats grama and little bluestem make up about 30 percent. The cool-season needleandthread, porcupinegrass, or both make up about 10 percent. Forbs, such as heath aster, scurfpea, and perennial sunflowers, make up about 5 percent. Shrubs, such as wild rose and leadplant, occur on the site but are not dominant.

The major management concern on this site is

maintaining the extent of the most productive grasses. The extent of big bluestem, sand bluestem, and porcupinegrass decreases after continuous grazing because the livestock prefer these plants. The extent of prairie sandreed, needleandthread, little bluestem, and sideoats grama initially increases as that of the other grasses decreases. After continuous overgrazing, these grasses thin out and are replaced by blue grama and bluegrasses. Low forage production is the result. The extent of the most productive grasses can be increased or maintained by using proper stocking rates and by using a deferred grazing or rotation grazing program, which provides rest periods during the key growing season of these plants.

Shallow Marsh range site. This site is ponded in spring and early summer. The potential native vegetation is water-tolerant, tall prairie grasses and sedges. Rivergrass and sedges make up about 75 percent of the vegetation. American mannagrass, cordgrasses, and reedgrass make up about 15 percent. Forbs, such as smartweed and waterplantain, make up about 10 percent.

The major management concern on this site is maintaining the extent of the most productive plants. If continued overgrazing is allowed, rivergrass and slough sedge are replaced by spikesedge and other grasslike plants, which are less palatable to livestock. An increase in the abundance of the less palatable vegetation results in a loss of available forage. The extent of the most productive plants can be maintained by using proper stocking rates and by using a deferred grazing program, which provides rest periods during the key growing season of these plants. Surface compaction is a potential problem during wet periods. Deferred grazing helps to prevent compaction and improves plant vigor.

Shallow to Gravel range site. The potential native vegetation on this site is mid prairie grasses. Needleandthread, which is a cool-season grass, makes up about 45 percent of the vegetation. Warm-season grasses make up about 35 percent. They include little bluestem, plains muhly, and prairie dropseed, which make up 25 percent of the vegetation, and blue grama and hairy grama, which make up 10 percent. Sedges, forbs, and shrubs make up about 15 percent of the vegetation.

The major management concern on this site is maintaining the extent of the most productive grasses. Needleandthread, little bluestem, plains muhly, and prairie dropseed rapidly thin out if continuous overgrazing is allowed. When the extent of these grasses decreases, the extent of sedges and blue grama or hairy grama increases. If overgrazing continues, the productivity of the site is greatly reduced. The extent of the most productive grasses can be maintained by using proper stocking rates and by using a rotation grazing or deferred grazing program, which provides rest periods during the key growing season of these plants.

Silty range site. The potential native vegetation on this site is tall and mid grasses and a large number of forbs. Cool-season grasses make up about 20 percent of the vegetation. They include green needlegrass and porcupinegrass. Warm-season grasses, such as little bluestem, big bluestem, and prairie dropseed, make up about 55 percent of the vegetation. Forbs, such as blacksamson, dotted gayfeather, stiff sunflower, heath aster, and prairie-clover, and shrubs, such as leadplant, rose, and western snowberry, make up about 10 percent.

The major management concern on this site is maintaining the extent of the most productive grasses. If continuous grazing is allowed, the extent of big bluestem, prairie dropseed, porcupinegrass, and green needlegrass decreases because the livestock prefer these plants. Little bluestem and sideoats grama initially increase after continuous grazing. If continuous overgrazing is allowed, however, short grasses, such as blue grama, annual bromes, and bluegrasses, become the dominant plants. Low forage production is the result. The extent of the most productive grasses can be increased or maintained by using proper stocking rates and by using a deferred grazing or rotation grazing program, which provides rest periods during the key growing season of the desirable plants.

Subirrigated range site. The potential native vegetation on this site is dominantly tall, warm-season grasses. Big bluestem is the dominant warm-season grass. It makes up about 50 percent of the vegetation. Prairie cordgrass, switchgrass, indiangrass, and little bluestem make up about 35 percent. Forbs, such as American licorice, Maximilian sunflower, downy gentian, Canada milkvetch, heath aster, and Missouri goldenrod, make up about 5 percent.

The major management concern on this site is maintaining the extent of the most productive tall grasses. After continuous grazing, the extent of big bluestem, indiangrass, switchgrass, and forbs, such as Maximilian sunflower, decreases because the livestock prefer these plants. Little bluestem, sideoats grama, and sedges initially increase after continuous grazing. If continuous overgrazing is allowed, however, short grasses, such as bluegrasses, downy brome, and sedges, become the dominant plants. Low forage

production is the result. The extent of the most productive tall grasses can be maintained by using proper stocking rates and by using a rotation grazing or deferred grazing program, which provides rest periods during the key growing season of these plants.

Thin Claypan range site. The potential native vegetation is a mixture of mid and short grasses. Western wheatgrass is the principal mid grass. It makes up about 55 percent of the vegetation. Blue grama, the principal short grass, makes up about 25 percent. Buffalograss, saltgrass, and sedges occur in smaller amounts. Forbs, such as sageworts, heath aster, broom snakeweed, and woody plantain, generally make up less than 5 percent of the vegetation. Pricklypear is the dominant shrub on this site, but it makes up only a small percentage of the plant community.

The major management concern on this site is maintaining the most productive grasses. If overgrazing is allowed, western wheatgrass is replaced by blue grama, buffalograss, and saltgrass. If overgrazing continues, a considerable amount of the surface will be left bare, especially during dry periods. During wet periods, overgrazed areas may be overrun by weeds. The most productive grasses can be maintained by using proper stocking rates and by using a rotation grazing or deferred grazing program, which provides rest periods during the key growing season of these plants.

Thin Upland range site. The potential native vegetation on this site consists of tall and mid grasses and a large number of forbs. Warm-season grasses make up 60 percent of the vegetation. These include little bluestem, which makes up 35 percent of the vegetation; prairie dropseed and big bluestem, which make up 20 percent; and sideoats grama, which makes up 5 percent. Cool-season grasses, such as green needlegrass, porcupinegrass, and needleandthread, make up about 20 percent of the vegetation. Forbs, such as pasqueflower, dotted gayfeather, and blacksamson, and woody plants, such as leadplant and rose, make up about 10 percent.

The major management concern on this site is maintaining the extent of the most productive grasses. Prairie dropseed, big bluestem, and porcupinegrass lose their productive capacity and thin out after continuous grazing because the livestock prefer these plants. The extent of little bluestem, sideoats grama, and needleandthread initially increases as the other grasses thin out. After continuous overgrazing, short grasses, such as blue grama, dominate the site. Low forage production is the result. The extent of the most productive grasses can be increased or maintained by using proper stocking rates and by using a deferred grazing or rotation grazing program, which provides rest periods during the key growing season of the desirable plants.

Very Shallow range site. The potential native vegetation on this site is mid and short grasses. Needleandthread, plains muhly, and sideoats grama are the dominant mid grasses. These species make up about 65 percent of the vegetation. Short grasses, such as blue grama and hairy grama, and sedges make up about 30 percent. Forbs, such as dotted gayfeather, blacksamson, and sagewort, make up about 5 percent. Shrubs, such as leadplant and wild rose, occur in smaller amounts.

The main management concern on this site is maintaining a good stand of grasses. If overgrazing is allowed, the site rapidly deteriorates to a stand of grama grasses, threadleaf sedge, and a few unpalatable forbs. If overgrazing continues, the stand of short grasses may thin out and much of the site is subject to erosion. A productive cover of grasses can be maintained by using proper stocking rates and by using a deferred grazing or rotation grazing program, which provides rest periods during the key growing season of the desirable plants.

Wetland range site. This range site has the potential to produce a luxuriant stand of grasses that tolerate a high water table. Because areas of this site are often under water during the spring, their use is limited to summer and fall. Prairie cordgrass is the dominant species. It makes up about 55 percent of the vegetation. Reedgrasses, reed canarygrass, switchgrass, Canada wildrye, bluegrasses, and sedges also grow on this site. They make up about 40 percent of the vegetation. Forbs, such as asters, waterhemlock, and giant goldenrod, and shrubs, such as indigo amorpha and willows, occur in small amounts.

The major management concern on this site is maintaining the most productive plants. If continued overgrazing is allowed, the stand of climax grasses loses vigor and density and sedges, rushes, bluegrasses, and saltgrass increase or invade. A less productive plant community is the result. The most productive grasses can be maintained by using proper stocking rates and by using a rotation or deferred rotation grazing system, which provides rest periods during the key growing season of these plants. Restricting grazing during wet periods helps to prevent surface compaction.

Wet Meadow range site. This range site has the potential to produce a luxuriant stand of sedges and

mid or tall grasses. Sedges are the dominant species. They make up about 40 percent of the vegetation. Tall grass species, such as reedgrasses, prairie cordgrass, and reed canarygrass, also make up about 40 percent of the vegetation. Mid grasses, such as western wheatgrass and bluegrasses, occur on the site but are not dominant. Forbs, such as smartweed, aster, and milkweed, are common but generally make up only about 5 percent of the vegetation. A few willows also grow on this site.

The major management concern on this site is maintaining the most productive grasses and sedges. Some areas are not usable by livestock during the spring and early summer because they are commonly ponded for about 4 to 8 weeks after periods of snowmelt or heavy rainfall. Surface compaction can be a problem if grazing is allowed during wet periods. If continued overgrazing is allowed, the extent of the tall grasses and the more palatable sedges decreases, the extent of the less palatable spikesedge and rushes increases, and weedy grasses, such as foxtail barley, invade. Low forage production is the result. The most productive grasses and sedges can be maintained by using proper stocking rates and by using a rotation grazing or deferred grazing program, which provides rest periods during the key growing season of these plants. Deferring grazing during wet periods helps to prevent surface compaction.

Native Woodland, Windbreaks, and Environmental Plantings

Thomas A. Hurford, resource conservationist, Natural Resources Conservation Service, helped prepare this section.

Native trees and shrubs grow on about 2,000 acres in Clark County. The soils that support trees and shrubs are not classified as woodland soils but as grassland soils that formed under a grassland influence. Prior to settlement, periodic fires prevented the widespread establishment of trees and shrubs throughout the county. Since the area was settled and fire-control efforts were incorporated, trees and shrubs have been established in some areas.

Native trees and shrubs occur in two primary areas in the county. One area is in the western part of the county along the major drainageways coming off the western aspect of the Coteau des Prairies. The soils in this area that support native trees and shrubs are mainly Aastad, Barnes, Holmquist, La Prairie, Lowe, and Svea soils. The second primary area occurs adjacent to scattered lakes in the eastern part of the county. In this area, Aastad, Barnes, Hamerly, Minnewasta, Minnewaukan, and Svea soils support native trees and shrubs.

The drainageways associated with the Coteau des Prairies in the western part of the county support mainly green ash. American elm, which once grew in these areas, has been eliminated by Dutch elm disease. Western snowberry, American plum, and chokecherry also grow in these areas.

Tree species in areas adjacent to the lakes and in depressional areas and wet draws include peachleaf willow, sandbar willow, and eastern cottonwood. Aastad, Buse, and Forman soils adjacent to the lakes support green ash, bur oak, hackberry, boxelder, chokecherry, western snowberry, American plum, smooth sumac, American elm, slippery elm, basswood, false indigo, and prickly ash.

Russian-olive, which is an introduced species, grows in areas of Holmquist, Playmoor, and Salmo soils on low flood plains. This species is tolerant of saline conditions.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. They protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife. They may consist of one or more rows of adapted trees and shrubs.

Farmstead and feedlot windbreaks are planted to protect buildings and livestock from the severe winter weather that is common in Clark County. In addition, these plantings provide winter cover for wildlife. They also help to beautify and screen houses and other buildings and to abate noise. Farmstead and feedlot windbreaks generally consist of multiple rows of adapted trees and shrubs. Many of the older plantings in the county have been neglected and are in need of renovation. Renovation may include planting additional trees adjacent to the existing windbreaks and controlling grasses within the older windbreaks. Competition from grass species, such as smooth bromegrass, is a major factor contributing to the decline of windbreaks in Clark County.

To ensure plant survival, locally adapted planting stock should be used and planted in a properly prepared site. If possible, the site should be one on which summer fallowing was practiced during the year prior to planting. Table 8 shows suitable trees and shrubs for planting as well as the expected 20-year height of the species on the various soils in the county.

At the end of each description under the heading "Detailed Soil Map Units" and in the section "Interpretive Groups," which follows the tables at the back of this survey, the soils are assigned to windbreak suitability groups. A windbreak suitability group is a distinctive group of soils that supports trees and shrubs having similar growth and survival rates if weather conditions are normal and the windbreak is properly

managed. The relationship between the soils and the growth of trees and shrubs was ascertained during this survey. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the growth of trees and shrubs. Soil reaction, salt content, and a seasonal high water table also are important. The windbreak suitability groups in this survey area are described in the following paragraphs.

Group 1.—The soils in this group are well suited to woody plantings. They are on foot slopes, toe slopes, and low and high flood plains. They receive additional moisture from runoff and flooding. Some areas are subirrigated. All climatically suited trees and shrubs grow well.

This group consists mainly of loamy, silty, and clayey, somewhat poorly drained to well drained soils that are very deep and deep. Available water capacity is moderate or high. The fine sandy loams and loamy fine sands are subject to severe wind erosion. Typical soils in this group are Aastad, Bonilla, Cubden, Divide, Hamerly, La Prairie, Prosper, Svea, and Waubay soils.

Group 2.—The soils in this group are well suited to woody plantings. They are on toe slopes and low and high flood plains. They receive additional moisture from runoff or have a high water table within the root zone. All climatically suited trees and shrubs grow well.

This group consists of very deep and deep, sandy, silty, loamy, and clayey, poorly drained and somewhat poorly drained soils. Available water capacity is high. The sandy loams and loamy fine sands are subject to severe wind erosion. Typical soils in this group are Badger, Crossplain, Fairdale, Lamo, Lowe, Marysland, Minnewaukan, and Ranslo soils.

Group 3.—The soils in this group are well suited to woody plantings. They are on summits, back slopes, and foot slopes. Except for those that require abundant moisture, all climatically suited trees and shrubs grow well.

This group consists of very deep and deep, loamy and silty, well drained soils. Available water capacity is moderate or high. The susceptibility to water erosion ranges from slight in the nearly level areas to severe in the strongly sloping areas. The susceptibility to wind erosion ranges from slight to severe. Typical soils in this group are Barnes, Clarno, Davison, Forman, Houdek, Kranzburg, and Poinsett soils.

Group 4.—The soils in this group are fairly well suited to woody plantings. They are on summits, back slopes, and foot slopes. Most of the climatically suited trees and shrubs grow well; however, maximum growth is not possible because of the limited root development.

This group consists of very deep, deep, and moderately deep, clayey soils and clayey soils that have a surface layer of loamy or silty material. The soils are moderately well drained and well drained. Available water capacity is low or moderate in the more clayey soils and moderate or high in the silty and loamy soils. Soils having accumulations of salts in the lower part of the subsoil also are in this group. The clayey soils are subject to severe wind erosion. The moderately sloping and strongly sloping soils are subject to severe water erosion. Typical soils in this group are Beadle, Cresbard, Hetland, Peever, Sinai, and Stickney soils.

Group 5.—The soils in this group are well suited to woody plantings. They are on summits, shoulder slopes, back slopes, and foot slopes. All climatically suited trees and shrubs grow well, except those that require abundant moisture.

This group consists mainly of very deep and deep, loamy and sandy, well drained and somewhat excessively drained soils. Available water capacity generally is low or moderate. The soils are subject to severe or very severe wind erosion. Typical soils in this group are Blendon, Egeland, Henkin, and Maddock soils.

Group 6.—The soils in this group are poorly suited to woody plantings. They are on summits, back slopes, and foot slopes. No trees and shrubs grow well on the soils in this group. Plantings can be established, but optimum survival and growth should not be expected. Field windbreaks are not effective because of the slow growth rate and the low height at maturity.

This group consists of silty and loamy, well drained and somewhat excessively drained soils that are moderately deep to bedrock or are shallow or moderately deep to sand and gravel. Available water capacity is low or moderate. The moderately sloping and strongly sloping soils are subject to severe erosion. Typical soils in this group are Delmont, Enet, Fordville, and Renshaw soils.

Group 7.—The soils in this group are poorly suited to woody plantings. No trees or shrubs grow well. Coniferous trees and shrubs are better suited than deciduous trees and shrubs. Plantings can be established, but optimum survival and growth should not be expected. Field windbreaks are not effective because of the slow growth rate and the low height at maturity.

This group consists of very deep, deep, and moderately deep, sandy, somewhat excessively drained and excessively drained soils. Available water capacity is very low or low. The soils are subject to very severe wind erosion. None of the soils in Clark County are assigned to this group.

Group 8.—The soils in this group are poorly suited to woody plantings. They are on shoulder slopes, back slopes, and foot slopes. No trees and shrubs grow well. Plantings can be established, but optimum survival and

growth should not be expected. Field windbreaks are not effective because of the slow growth rate and the low height at maturity.

This group consists of very deep, deep, and moderately deep, loamy and silty, well drained soils that contain enough calcium carbonate at or near the surface to adversely affect the growth and survival of trees and shrubs. Available water capacity is moderate or high. The soils are subject to severe wind erosion and water erosion. Typical soils in this group are Betts, Buse, Ethan, and Rusklyn soils.

Group 9.—The soils in this group are poorly suited to woody plantings. They have a dense claypan subsoil and an excessive amount of salt in the lower part of the subsoil. They are on summits, back slopes, foot slopes, and high flood plains. No trees and shrubs grow well because of the adverse effects of the dense claypan subsoil and the salts.

This group consists of very deep and deep, silty and loamy, moderately well drained soils. Available water capacity is low or moderate. Typical soils in this group are Cavour, Dudley, and Farmsworth soils.

Group 10.—The soils in this group generally are unsuited to woody plantings. The soils are shallow to bedrock, very shallow to gravel, very saline, very alkaline, stony, or very wet. Specialized plantings for wildlife, recreation, or beautification may be established in some areas. The most favorable sites should be selected, and only those trees and shrubs that have the best potential to survive and grow should be planted.

The soils in this group have a wide range of texture, depth, drainage, available water capacity, permeability, and slope characteristics. Susceptibility to water erosion and wind erosion ranges from slight to very severe. Typical soils in this group are Buse, Colvin, Durrstein, Ferney, Harriet, Heil, Holmquist, Hoven, Jerauld, Langhei, Ludden, Mauvais, Minnewasta, Oldham, Parnell, Rauville, Renshaw, Salmo, Sioux, Southam, Tetonka, Tonka, Vallers, and Worthing soils and the gravelly Orthents.

Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local offices of the Natural Resources Conservation Service or the South Dakota Cooperative Extension Service or from a commercial nursery.

Recreation

The soils of the survey area are rated in table 9 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 sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, 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 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

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 and horseback riding

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

Wildlife Habitat

Connie M. Vicuna, biologist, Natural Resources Conservation Service, helped prepare this section.

Clark County provides a variety of wildlife habitat types, including rangeland, cropland, and wetlands. Wildlife species include white-tailed deer, gray partridge, dove, cottontail rabbits, squirrels, pheasants, ducks, geese, other waterbirds, beaver, mink, muskrats, fox, coyotes, raccoons, and skunks. A small population of antelope resides in the northwestern part of the county. Prairie chickens and sharptail grouse may also inhabit the county. Round Lake and Bailey's Lake contain walleye, perch, and bullheads. Fordham Dam supports bullheads and a few northern pike.

Wetlands are numerous throughout the county. They include mainly basins and a few narrow flood plains coming off the western aspect of the Coteau des Prairies. The size of these wetlands ranges from less than 0.1 acre to 2,000 acres. Water regimes are also variable and include many temporary and a few permanent waters. The variety and number of wetland areas are extremely attractive to waterfowl. Ducks, geese, herons, and other waterbirds inhabit the survey area from spring through fall.

Rangeland habitat is abundant in the steep, rolling hills of the Coteau des Prairies. The grasslands in this part of the county are intermixed with wetlands and provide the type of habitat that makes this area important for waterfowl production.

Woody habitat is limited in Clark County. It includes areas along the channels and upland breaks of some of the major drainageways and near some of the small lakes and adjacent slopes. These shrubby and wooded areas are very important for many wildlife species and provide either food or cover during some part of the year.

Soils affect the kind and amount of vegetation that is available for 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 10, the soils in the survey area are rated according to their potential for providing specific elements of wildlife habitat. 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 the habitat elements; and in determining the intensity of management needed for each habitat element.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element 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 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. The element can be established, 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 are very severe and that unsatisfactory results can be expected. Establishing, improving, or maintaining the element 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. They are primarily food sources for wildlife, but small grain crops also provide some nesting cover. 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 flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, sorghum, wheat, oats, barley, rye, soybeans, and sunflowers.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. They provide nesting and roosting cover. 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, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are intermediate wheatgrass, bromegrass, and alfalfa.

Native herbaceous plants are native or naturally established grasses and forbs, including weeds. They provide food, nesting cover, and escape cover. 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 flooding. Soil temperature and soil moisture are also considerations. Examples of native

herbaceous plants are big bluestem, switchgrass, indiangrass, green needlegrass, and sideoats grama.

Planted woody plants include trees and shrubs that require cultivation before and during establishment. These plants provide fruit, buds, twigs, bark, and foliage and are important as food sources, nesting cover, winter cover, and escape cover. Soil properties and features that affect the growth of trees and shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of planted woody plants are green ash, hackberry, caragana, plum, chokecherry, Rocky Mountain juniper, and eastern redcedar.

Native deciduous trees and woody understory produce nuts or other fruit, buds, twigs, bark, and foliage. They provide food for wildlife and are important as winter cover and escape cover. Soil properties and features that affect the growth of these trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are elm, cottonwood, ash, bur oak, willow, plum, and chokecherry.

Native coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Eastern redcedar is the primary example of these plants in the survey area.

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

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. They provide food and nesting cover. 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, cattails, sloughgrass, whitetop, 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.

Additional information concerning maintaining and managing specific wildlife species is available at the local office of the Natural Resources Conservation Service; the South Dakota Department of Game, Fish, and Parks; or the United States Fish and Wildlife 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. Ratings are given for 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 feet. Because of the map scale, small areas of different soils are often 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 soil 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 should 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, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding or ponding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds 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 evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology;

locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and 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 11 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 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 or ponding. 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, ponding, and shrinking and swelling can cause the movement of footings. A high water table, large stones, slope, flooding, and ponding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 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. A high water table, flooding, ponding, 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 12 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 12 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, ponding, and flooding

affect absorption of the effluent. Large stones 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 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 12 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, flooding, ponding, large stones, and content of organic matter.

Excessive seepage resulting from 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 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 should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, slope, ponding, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench 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 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 wind erosion.

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 13 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 about 5 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 about 5 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 to 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, a 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 a 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 have a water table at a depth of 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. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, 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. Reaction 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 contains 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, salinity, cation-exchange capacity, percent base saturation, types of bases, 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, 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, have a favorable soil pH, 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 a favorable soil pH, have slopes of more than 15 percent, or have a seasonal high 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 14 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 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; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected 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. 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 control erosion and conserve moisture by intercepting runoff. Slope, wetness, and large stones affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion 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, and slope affect the construction of grassed waterways. Low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the establishment, 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 to characterize key soils.

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

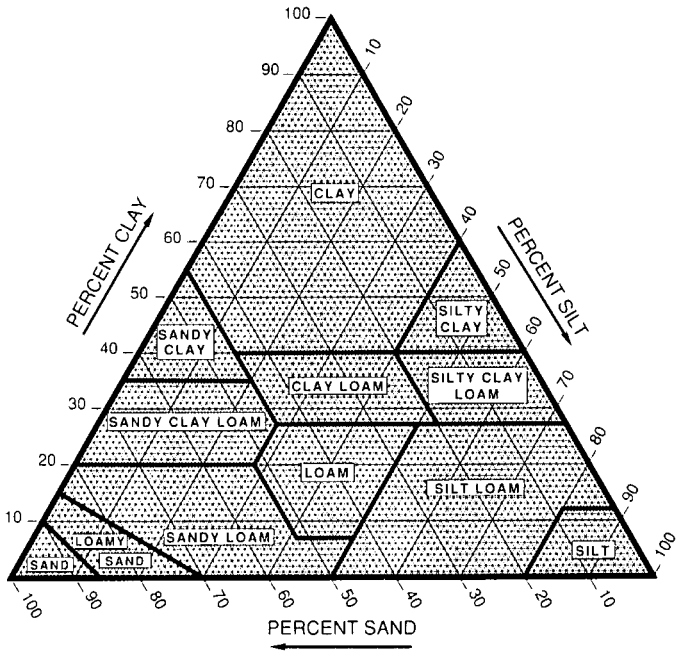

Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 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. Information on other properties of each layer is given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 12). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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

highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

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

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

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

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

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

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

Physical and Chemical Properties

Table 16 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. Clay minerals determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-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 and management of irrigation systems, the development of nutrient and pesticide management plans, and the design of soil drainage systems and septic tank absorption fields.

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, in the selection of a tillage system, in the management of crop residue, 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 selecting pesticides, 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 based on 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), soil structure, and permeability. Values of K range from 0.05 to 0.69. The higher the K 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 wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, 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 coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous 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 wind erosion are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, 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 in a soil can be maintained or increased by limiting the removal of residue, by including high-residue crops in the rotation a

high percentage of the time, and by applying agricultural waste to the soil. Applications of agricultural waste should be made only in an environmentally acceptable manner. Organic matter affects the available water capacity, infiltration rate, pesticide efficiency and persistence, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 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 infiltration 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, deep, or very 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.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

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

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

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 little or no horizon development.

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 estimates apply only in areas where the soils are not artificially drained. They are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 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 17.

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.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of

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

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe hazard of corrosion. 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 (USDA, 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven 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 Boroll (*Bor*, meaning cool, 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 Haploborolls (*Hapl*, meaning minimal horizonation, plus *borolls*, the suborder of the Mollisols that has a cool temperature 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. An example is Udic Haploborolls.

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

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 parent material in which it formed are identified for each 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" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). 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."

Aastad Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains

Parent material: Loamy glacial till
Slope: 0 to 6 percent

Typical Pedon

Aastad loam, in an area of Forman-Aastad loams, 1 to 6 percent slopes, 220 feet north and 660 feet west of the southeast corner of sec. 2, T. 116 N., R. 59 W.

A1—0 to 10 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine vesicular and tubular pores; about 2 percent pebbles; slightly acid; clear smooth boundary.

A2—10 to 18 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular pores; about 2 percent pebbles; neutral; clear smooth boundary.

Bw1—18 to 23 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular pores; about 2 percent pebbles; neutral; gradual smooth boundary.

Bw2—23 to 32 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; common very fine vesicular and tubular pores; about 2 percent pebbles; neutral; clear smooth boundary.

Bk—32 to 44 inches; light yellowish brown (2.5Y 6/3) clay loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; about 5 percent pebbles; violent effervescence; slightly alkaline; gradual smooth boundary.

C—44 to 60 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; common fine prominent strong brown (7.5YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; very few prominent dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 8 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 24 inches
Depth to carbonates: 18 to 40 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 45 to more than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly loam; clay loam in some pedons

Bw horizon:
Hue—2.5Y or 10YR
Value—3 to 5 (2 to 4 moist)
Chroma—2 to 4
Texture—clay loam

Bk horizon:
Hue—2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay loam or loam

Badger Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Badger silty clay loam, in an area of Badger-Tonka silty clay loams, 540 feet north and 2,300 feet west of the southeast corner of sec. 5, T. 115 N., R. 56 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; slightly acid; abrupt smooth boundary.

A—7 to 15 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to moderate medium granular; hard, friable, slightly sticky and slightly plastic; common very fine roots; common

fine vesicular and tubular pores; slightly acid; clear smooth boundary.

Bt1—15 to 22 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; strong medium prismatic structure parting to strong medium subangular blocky; very hard, firm, sticky and plastic; few very fine roots; shiny films on faces of peds; slightly acid; clear wavy boundary.

Bt2—22 to 30 inches; gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist; moderate medium prismatic structure parting to strong medium subangular blocky; very hard, firm, sticky and plastic; shiny films on faces of peds; slightly acid; clear wavy boundary.

BCg—30 to 38 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; common fine prominent brownish yellow (10YR 6/6) and few fine prominent very dark gray (10YR 3/1) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

Cg1—38 to 52 inches; light gray (5Y 7/1) silt loam, gray (5Y 6/1) moist; common fine prominent yellowish brown (10YR 5/8) and very dark grayish brown (10YR 3/2) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine soft masses of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.

Cg2—52 to 60 inches; light gray (5Y 7/1) silt loam, light brownish gray (2.5Y 6/2) moist; common fine prominent yellowish brown (10YR 5/6) and few fine prominent very dark gray (10YR 3/1) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine soft masses of carbonate; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 36 inches
Depth to carbonates: 35 to more than 60 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over glacial till
Depth to gypsum and other salts: 45 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silty clay loam; silt loam, clay loam, or loam in some pedons

Bt horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6 (2 to 5 moist)
Chroma—1 or 2
Texture—dominantly silty clay loam, silty clay, or clay; clay loam in some pedons

Bk or BCg horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—1 to 4
Texture—dominantly silty clay loam, silty clay, or clay loam; silt loam or loam in some pedons

Cg horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—1 to 6
Texture—silt loam, silty clay loam, clay loam, sandy clay loam, or loam

Barnes Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Loamy glacial till
Slope: 0 to 25 percent

Typical Pedon

Barnes loam, in an area of Barnes-Buse-Svea loams, 1 to 6 percent slopes, 1,450 feet north and 150 feet east of the southwest corner of sec. 7, T. 117 N., R. 58 W.

A—0 to 7 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate fine granular structure; slightly hard, friable; common fine and very fine roots; about 2 percent pebbles; moderately acid; abrupt smooth boundary.

Bw—7 to 15 inches; brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) crushing to dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common fine and very fine roots; many fine vesicular and tubular pores; about 2 percent pebbles; slightly acid; clear wavy boundary.

Bk1—15 to 27 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; weak medium and coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots in the upper part; common fine vesicular and tubular pores; common fine soft masses of carbonate; about 3 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Bk2—27 to 34 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure; hard, friable, slightly

sticky and slightly plastic; few very fine roots in the upper part; common fine vesicular and tubular pores; common fine soft masses of carbonate; about 3 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—34 to 54 inches; light yellowish brown (2.5Y 6/3) clay loam, olive brown (2.5Y 4/3) moist; many fine distinct gray (N 6/0) and common fine prominent strong brown (7.5YR 4/6) mottles; massive; very hard, friable, slightly sticky and slightly plastic; few roots; few pebbles; few fine soft masses of carbonate; about 3 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—54 to 60 inches; light yellowish brown (2.5Y 6/3) clay loam, olive brown (2.5Y 4/3) moist; many fine distinct light gray (N 7/0) and common fine prominent reddish yellow (7.5YR 6/6) mottles; massive; very hard, firm, slightly sticky and slightly plastic; few fine soft masses of carbonate; about 3 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Depth to carbonates: 10 to 20 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; fine sandy loam, sandy loam, clay loam, sandy clay loam, or silt loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 6 (2 to 5 moist)
Chroma—2 to 4
Texture—loam, clay loam, or sandy clay loam

Bk horizon:
Hue—10YR or 2.5Y
Value—5 to 8 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR or 2.5Y
Value—4 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

Beadle Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Till plains and moraines
Parent material: Clayey glacial till
Slope: 0 to 9 percent

Typical Pedon

Beadle loam, 2 to 6 percent slopes, 1,100 feet east and 160 feet north of the southwest corner of sec. 31, T. 113 N., R. 58 W.

A—0 to 8 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; many very fine roots and common fine roots; about 2 percent pebbles; neutral; clear smooth boundary.

Bt—8 to 15 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common very fine roots; few very fine vesicular and tubular pores; shiny films on faces of peds; about 2 percent pebbles; slightly alkaline; gradual wavy boundary.

Bk1—15 to 23 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common very fine roots; common very fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; about 3 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Bk2—23 to 33 inches; light yellowish brown (2.5Y 6/3) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; very hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C—33 to 60 inches; light yellowish brown (2.5Y 6/3) clay loam, olive brown (2.5Y 4/3) moist; common fine prominent strong brown (7.5YR 5/8) and common yellowish red (5YR 5/8) mottles; massive; very hard, firm, slightly sticky and slightly plastic; few dark reddish brown (5YR 3/2) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 8 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 20 inches
Depth to carbonates: 12 to 25 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam or clay loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (3 or 4 moist)
Chroma—1 to 3
Texture—clay or clay loam

Bk horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 or 3
Texture—clay loam or clay

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay loam or clay

Betts Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Loamy glacial till
Slope: 9 to 20 percent

Typical Pedon

Betts loam, in an area of Betts-Ethan loams, 9 to 20 percent slopes, 100 feet east and 2,420 feet south of the northwest corner of sec. 33, T. 114 N., R. 59 W.

A—0 to 5 inches; dark gray (10YR 4/1) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; many very fine roots; few very fine and fine vesicular and tubular pores; about 2 percent pebbles; strong effervescence; neutral; clear wavy boundary.

Bw—5 to 11 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common very fine roots; many very fine and fine vesicular and tubular pores; few fine irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

BCk—11 to 26 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine vesicular and tubular pores; very few prominent dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; many fine and medium irregular soft masses of carbonate; about 4 percent pebbles; violent effervescence; slightly alkaline; gradual wavy boundary.

C1—26 to 34 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; many fine and medium prominent reddish yellow (7.5YR 6/8) mottles; massive; very hard, firm, slightly sticky and slightly plastic; many dark brown (7.5YR 3/4) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 8 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—34 to 60 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; many fine and medium prominent reddish yellow (7.5YR 6/8) mottles; massive; very hard, firm, slightly sticky and slightly plastic; common dark brown (7.5YR 3/4) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 8 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 3 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 to 6 (2 to 5 moist)
Chroma—1 to 3
Texture—dominantly loam; clay loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—5 or 6 (4 or 5 moist)
Chroma—2 or 3
Texture—loam or clay loam

BCk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

Blendon Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Loamy glaciofluvial sediments
Slope: 0 to 6 percent

Typical Pedon

Blendon fine sandy loam, in an area of Henkin-Blendon fine sandy loams, 2 to 6 percent slopes, 1,850 feet south and 2,630 feet east of the northwest corner of sec. 5, T. 110 N., R. 57 W.; in Kingsbury County, South Dakota:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; soft, friable; common fine and very fine roots; slightly acid; abrupt smooth boundary.

Bw—8 to 22 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; common fine and very fine roots; neutral; gradual wavy boundary.

C1—22 to 42 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable; few fine and very fine roots; slightly alkaline; gradual wavy boundary.

C2—42 to 60 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; single grain; loose; slight effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 36 inches
Depth to carbonates: 40 to more than 60 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over glacial till
Depth to gypsum and other salts: Greater than 60 inches
Other features: A BC horizon in some pedons

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly fine sandy loam; loam or sandy loam in some pedons

Bw horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 to 3
Texture—fine sandy loam, sandy loam, or loam

C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (3 to 6 moist)
Chroma—2 to 4
Texture—dominantly loamy fine sand, loamy sand, or sandy loam; fine sandy loam, gravelly sandy loam, gravelly fine sandy loam, sand, or fine sand in some pedons

Bon Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Loamy alluvium
Slope: 0 to 2 percent

Typical Pedon

Bon loam, channeled, 900 feet south and 850 feet west of the northeast corner of sec. 29, T. 114 N., R. 59 W.

A1—0 to 6 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; many very fine and fine roots; common very fine vesicular and tubular pores; neutral; clear smooth boundary.

A2—6 to 16 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable; many very fine roots; many very fine and fine tubular pores; slight effervescence; slightly alkaline; clear smooth boundary.

A3—16 to 18 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable; many very fine roots; many very fine tubular pores; strong effervescence; slightly alkaline; clear smooth boundary.

Bw1—18 to 24 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium prismatic

structure; hard, friable; common very fine roots; common very fine vesicular and tubular pores; strong effervescence; slightly alkaline; clear smooth boundary.

Bw2—24 to 28 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, very friable; common very fine roots; common very fine vesicular and tubular pores; strong effervescence; slightly alkaline; clear smooth boundary.

Bk—28 to 48 inches; gray (10YR 5/1) loam, dark gray (10YR 4/1) moist; weak medium subangular blocky structure; hard, very friable; common very fine roots; common very fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; violent effervescence; slightly alkaline; gradual smooth boundary.

Akb—48 to 60 inches; dark gray (10YR 4/1) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, friable; common very fine roots; common very fine tubular pores; common fine and medium irregular soft masses of carbonate; violent effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to more than 60 inches

Depth to carbonates: 0 to 20 inches

Depth to contrasting or impervious layer: Greater than 60 inches

Depth to gypsum and other salts: Greater than 60 inches

Other features: A C horizon in some pedons

A horizon:

Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam or very fine sandy loam in some pedons

Bw horizon:

Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—1 to 3
Texture—loam, silt loam, or very fine sandy loam

Bk horizon:

Hue—10YR or 2.5Y
Value—3 to 7 (2 to 5 moist)
Chroma—1 to 3
Texture—dominantly loam, silt loam, or fine sandy loam; stratified clay loam or silty clay loam in some pedons

Bonilla Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 6 percent

Typical Pedon

Bonilla loam, in an area of Clarno-Ethan-Bonilla loams, 1 to 6 percent slopes, 880 feet north and 390 feet west of the southeast corner of sec. 32, T. 113 N., R. 57 W.

A1—0 to 6 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, very friable; many very fine and fine roots; neutral; clear smooth boundary.

A2—6 to 13 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; many very fine and fine roots; few very fine and fine tubular pores; neutral; clear smooth boundary.

Bw1—13 to 20 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable; many very fine roots; common very fine and fine tubular pores; neutral; clear smooth boundary.

Bw2—20 to 27 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable; many very fine and fine roots; common very fine and fine tubular pores; many fine and medium irregular soft masses of carbonate; neutral; clear smooth boundary.

Bk—27 to 35 inches; light brownish gray (10YR 6/2) loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, very friable; common very fine and fine roots; many very fine and fine tubular pores; many fine and medium irregular soft masses of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.

C1—35 to 44 inches; light brownish gray (2.5Y 6/2) loam, light olive brown (2.5Y 5/3) moist; few fine prominent yellowish red (5YR 4/6) mottles; massive; slightly hard, friable; few very fine roots; many very fine tubular pores; few fine irregular soft masses of carbonate; about 2 percent pebbles; strong effervescence; slightly alkaline; clear smooth boundary.

C2—44 to 53 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/3) moist; common fine prominent yellowish red (5YR 4/6) mottles; massive; slightly hard, firm, slightly sticky and slightly plastic; few fine irregular soft masses of carbonate; about 4 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C3—53 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/3) moist; common fine prominent yellowish red (5YR 4/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; few fine irregular soft masses of carbonate; about 8 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 40 inches
Depth to carbonates: 20 to 40 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 50 to more than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; fine sandy loam or silt loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5 (2 to 4 moist)
Chroma—1 to 3
Texture—loam or clay loam

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—6 or 7 (4 or 5 moist)
Chroma—1 to 3
Texture—dominantly loam or clay loam; silt loam or silty clay loam in some pedons

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—6 or 7 (4 or 5 moist)
Chroma—1 to 4
Texture—dominantly loam or clay loam; stratified silt loam, fine sandy loam, clay loam, silty clay loam, or loamy sand in some pedons

Buse Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Loamy glacial till
Slope: 3 to 40 percent

Typical Pedon

Buse loam, in an area of Barnes-Buse-Svea loams, 1 to 6 percent slopes, 1,050 feet north and 2,450 feet east of the southwest corner of sec. 19, T. 118 N., R. 58 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate medium subangular blocky structure parting to moderate fine granular; hard, firm, slightly sticky and slightly plastic; many very fine and fine roots; about 2 percent pebbles; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bk—7 to 20 inches; pale yellow (2.5Y 7/4) loam, light olive brown (2.5Y 5/4) moist; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; few fine vesicular and tubular pores; common fine soft masses of carbonate; about 2 percent pebbles; violent effervescence; moderately alkaline; clear wavy boundary.

C—20 to 60 inches; pale yellow (2.5Y 7/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine prominent brownish yellow (10YR 6/6) and yellowish red (5YR 4/6) mottles; massive; very hard, very firm, slightly sticky and slightly plastic; few very fine and fine roots; few fine soft masses of carbonate; about 4 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 10 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; clay loam in some pedons

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 8 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 7 (4 to 6 moist)
Chroma—2 to 6

Texture—loam or clay loam

Cavour Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 2 percent

Typical Pedon

Cavour loam, in an area of Cresbard-Cavour loams, 1,848 feet south and 1,134 feet west of the northeast corner of sec. 5, T. 114 N., R. 58 W.

A—0 to 9 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable; common fine roots; common very fine vesicular and tubular pores; neutral; abrupt wavy boundary.

E—9 to 13 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate medium blocky structure parting to weak thin and medium platy; slightly hard, friable; common fine roots; common very fine vesicular and tubular pores; neutral; abrupt smooth boundary.

Btn—13 to 18 inches; dark grayish brown (10YR 4/2) clay, very dark gray (10YR 3/1) moist; strong medium and coarse prismatic structure parting to strong fine and medium subangular blocky; extremely hard, very firm, sticky and plastic; few fine roots; few very fine vesicular and tubular pores; shiny films on faces of peds; about 2 percent pebbles; slightly alkaline; abrupt wavy boundary.

Btnz—18 to 30 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure; extremely hard, firm, sticky and plastic; few fine roots; common very fine vesicular and tubular pores; shiny films on faces of peds; common gypsum crystals and other salts; about 2 percent pebbles; slightly alkaline; abrupt wavy boundary.

Bk—30 to 44 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few fine roots; many very fine vesicular and tubular pores; common fine soft masses of carbonate; few gypsum crystals and other salts; about 2 percent pebbles; violent effervescence; slightly alkaline; gradual wavy boundary.

C1—44 to 56 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; few fine prominent yellowish brown (10YR 5/6) mottles; massive; very hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine vesicular and tubular pores; very few prominent very dark gray (10YR 3/1) accumulations of iron and manganese oxide; violent effervescence; slightly alkaline; few salt masses; about 3 percent pebbles; gradual wavy boundary.

C2—56 to 60 inches; pale olive (5Y 6/3) clay loam, grayish brown (2.5Y 5/2) moist; common fine prominent gray (5Y 6/1), yellowish red (5YR 4/6), and light yellowish brown (10YR 6/4) mottles; massive; hard, firm, slightly sticky and slightly plastic; few very fine vesicular and tubular pores; few salt masses; about 3 percent pebbles; violent effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 35 inches
Depth to carbonates: 14 to 35 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 16 to 45 inches

A horizon:
Hue—10YR or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly loam; silt loam or clay loam in some pedons

E horizon:
Hue—10YR
Value—3 to 7 (2 to 5 moist)
Chroma—1 or 2
Texture—dominantly loam or silt loam; fine sandy loam in some pedons

Btn horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 to 3
Texture—clay loam, clay, silty clay, or silty clay loam

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 or 6 (4 or 5 moist)
Chroma—1 to 3
Texture—loam, clay loam, silty clay loam, silty clay, or clay

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 or 5 moist)
Chroma—1 to 4
Texture—loam or clay loam

Clarno Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Loamy glacial till
Slope: 0 to 9 percent

Typical Pedon

Clarno loam, in an area of Clarno-Ethan-Bonilla loams, 1 to 6 percent slopes, 1,500 feet east and 780 feet north of the southwest corner of sec. 35, T. 113 N., R. 57 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; about 2 percent pebbles; slightly acid; abrupt smooth boundary.

Bw1—7 to 14 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine vesicular and tubular pores; about 2 percent pebbles; neutral; clear smooth boundary.

Bw2—14 to 21 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine vesicular and tubular pores; about 2 percent pebbles; neutral; clear smooth boundary.

Bk1—21 to 32 inches; pale brown (10YR 6/3) loam, olive brown (2.5Y 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; about 2 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Bk2—32 to 38 inches; pale brown (10YR 6/3) loam, olive brown (2.5Y 4/3) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; about 4 percent pebbles; strong effervescence; slightly alkaline; clear smooth boundary.

C—38 to 60 inches; pale yellow (2.5Y 7/3) loam, olive brown (2.5Y 4/3) moist; common fine prominent brownish yellow (10YR 6/8) and reddish yellow (7.5YR 6/8) mottles; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine and fine vesicular and tubular pores; very few prominent dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; few fine and medium irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 20 inches
Depth to carbonates: 12 to 26 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam or fine sandy loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—4 or 5 (2 to 4 moist)
Chroma—2 or 3
Texture—loam or clay loam

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 8 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

Colvin Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Silty glaciolacustrine sediments
Slope: 0 to 1 percent

Typical Pedon

Colvin silty clay loam, 2,580 feet west and 1,720 feet

north of the southeast corner of sec. 1, T. 114 N., R. 57 W.

A—0 to 8 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; common very fine vesicular pores; strong effervescence (about 9 percent calcium carbonate equivalent); slightly alkaline; abrupt smooth boundary.

Bkg1—8 to 26 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; few fine prominent brownish yellow (10YR 6/6) mottles; weak medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine vesicular and tubular pores; violent effervescence (about 21 percent calcium carbonate equivalent); slightly alkaline; clear smooth boundary.

Bkg2—26 to 35 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; many fine prominent brownish yellow (10YR 6/6) mottles; weak medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine vesicular and many very fine and fine tubular pores; strong effervescence (about 21 percent calcium carbonate equivalent); slightly alkaline; clear smooth boundary.

Bkg3—35 to 39 inches; light gray (5Y 7/2) silt loam, olive gray (5Y 5/2) moist; common fine prominent yellowish brown (10YR 5/8) mottles; weak medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine vesicular and many very fine and fine tubular pores; common medium and coarse irregular soft masses of carbonate; strong effervescence (about 20 percent calcium carbonate equivalent); slightly alkaline; gradual smooth boundary.

Bkg4—39 to 47 inches; light gray (5Y 7/2) silt loam, light olive gray (5Y 6/2) moist; many fine prominent brownish yellow (10YR 6/6) mottles; weak medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine vesicular and many very fine and fine tubular pores; very few prominent very dark grayish brown (10YR 3/2) discontinuous accumulations of iron and manganese oxide in root channels or pores or both; common medium rounded soft masses of carbonate; strong effervescence (about 13 percent calcium carbonate equivalent); slightly alkaline; clear wavy boundary.

Cg—47 to 60 inches; light yellowish brown (2.5Y 6/4) loamy very fine sand, olive brown (2.5Y 4/4) moist; many coarse distinct olive yellow (2.5Y 6/6) and common fine light gray (2.5Y 7/2) mottles; massive; soft, very friable; few very fine roots; many very fine vesicular and tubular pores; slight effervescence (about 9 percent calcium carbonate equivalent); slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 24 inches
Depth to carbonates: 0 to 6 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over finer or coarser material
Depth to gypsum and other salts: 30 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silty clay loam; silt loam in some pedons

Bk horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—5 to 8 (3 to 7 moist)
Chroma—0 to 3
Texture—dominantly silt loam or silty clay loam; clay loam in some pedons

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (3 to 6 moist)
Chroma—1 to 4
Texture—dominantly silt loam or silty clay loam; clay loam or loamy fine sand in some pedons

Cresbard Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 6 percent

Typical Pedon

Cresbard loam, in an area of Forman-Cresbard loams, 0 to 2 percent slopes, 1,300 feet south and 120 feet west of the northeast corner of sec. 35, T. 115 N., R. 59 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; many very fine and fine roots; common very fine vesicular and few tubular pores; moderately acid; abrupt smooth boundary.

E—9 to 10 inches; gray (10YR 6/1) loam, very dark

grayish brown (10YR 3/2) moist; weak thin and medium platy structure; slightly hard, very friable; common very fine and fine roots; common very fine vesicular and tubular pores; slightly acid; clear smooth boundary.

E/B—10 to 14 inches; 60 percent gray (10YR 6/1) (E) and 40 percent dark gray (10YR 4/1) (B) clay loam, very dark grayish brown (10YR 3/2) (E) and black (10YR 2/1) (B) moist; moderate medium prismatic structure parting to moderate very fine and fine blocky; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine tubular and common vesicular pores; slightly acid; clear smooth boundary.

Btn1—14 to 28 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate medium prismatic structure parting to strong medium blocky; very hard, firm, very sticky and very plastic; common very fine and fine roots; common very fine tubular pores; shiny films on faces of peds; about 1 percent pebbles; neutral; gradual wavy boundary.

Btn2—28 to 34 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to strong medium blocky; extremely hard, firm, sticky and plastic; common very fine and fine roots; common very fine tubular pores; common prominent dark gray (10YR 4/1) continuous shiny films on vertical and horizontal faces of peds; about 1 percent pebbles; neutral; clear wavy boundary.

Bk—34 to 55 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; many coarse distinct gray (10YR 5/1) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak very fine and fine subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine tubular pores; common medium irregular soft masses of carbonate; about 3 percent pebbles; strong effervescence; slightly alkaline; gradual irregular boundary.

C—55 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; many medium distinct gray (10YR 6/1) and many fine prominent yellowish brown (10YR 5/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; many very fine vesicular and tubular pores; few fine rounded soft masses of carbonate; about 2 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 36 inches
Depth to carbonates: 15 to 40 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches
Other features: Some pedons have a B/E or BE horizon.

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam in some pedons

E horizon:
Hue—10YR
Value—5 or 6 (2 to 4 moist)
Chroma—1 or 2
Texture—loam or silt loam

Btn horizon:
Hue—10YR or 2.5Y
Value—3 to 6 (2 to 4 moist)
Chroma—1 to 3
Texture—silty clay, clay loam, or clay

Bk horizon:
Hue—2.5Y or 5Y
Value—3 to 6 (2 to 4 moist)
Chroma—1 to 3
Texture—clay loam, loam, or silt loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay loam, loam, or silt loam

Crossplain Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Local clayey alluvium over loamy glacial till
Slope: 0 to 2 percent

Typical Pedon

Crossplain clay loam, in an area of Crossplain-Tetonka complex, 1,680 feet east and 50 feet south of the northwest corner of sec. 32, T. 113 W., R. 58 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; neutral; abrupt smooth boundary.

Bt—9 to 22 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and slightly plastic; common very fine roots and few fine roots between peds; common very fine and fine vesicular and tubular pores; continuous shiny films on faces of peds; slightly acid; clear wavy boundary.

Btg1—22 to 26 inches; olive gray (5Y 4/2) clay, dark olive gray (5Y 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common very fine roots and few fine roots between peds; common very fine tubular and few fine vesicular pores; tongues of black (5Y 2.5/1) on vertical faces of peds; continuous shiny films on faces of peds; neutral; clear wavy boundary.

Btg2—26 to 34 inches; olive gray (5Y 4/2) clay, dark olive gray (5Y 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and plastic; common very fine roots and few fine roots between peds; common very fine tubular and few fine vesicular pores; tongues of black (5Y 2.5/1) on vertical faces of peds; continuous shiny films on faces of peds; neutral; clear smooth boundary.

Bkg1—34 to 44 inches; gray (5Y 6/1) and light gray (5Y 7/2) clay loam, dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) moist; common fine prominent strong brown (7.5YR 5/8) and common dark reddish brown (5YR 3/2) mottles; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine and fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; strong effervescence; slightly alkaline; clear smooth boundary.

Bkg2—44 to 54 inches; gray (5Y 6/1) and light gray (5Y 7/2) clay loam, dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) moist; many fine prominent dark reddish brown (5YR 3/2) and common strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine and medium irregular soft masses of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.

Cg—54 to 60 inches; gray (5Y 6/1) and light gray (5Y 7/1) clay loam, dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) moist; many fine prominent dark reddish brown (5YR 3/2) and common strong brown (7.5YR 5/8) mottles; massive; very hard, firm, slightly sticky and slightly plastic; few fine and medium irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 36 inches
Depth to carbonates: 16 to 48 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches
Other features: An AB horizon in some pedons

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly clay loam; silt loam, silty clay loam, or loam in some pedons

Bt horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6 (2 to 4 moist)
Chroma—1 or 2
Texture—clay loam or clay

Bk horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 or 5 moist)
Chroma—1 to 3
Texture—clay loam or loam

Cg horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 or 5 moist)
Chroma—1 to 3
Texture—loam or clay loam

Cubden Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Silty glacial till
Slope: 0 to 2 percent

Typical Pedon

Cubden silty clay loam, in an area of Cubden-Tonka silty clay loams, 80 feet south and 2,300 feet west of the northeast corner of sec. 15, T. 116 N., R. 56 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few very fine irregular soft masses of carbonate; strong effervescence (about 9 percent calcium carbonate

equivalent); slightly alkaline; abrupt smooth boundary.

ABk—10 to 14 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few fine and very fine tubular pores; many fine and very fine irregular soft masses of carbonate; strong effervescence (about 16 percent calcium carbonate equivalent); moderately alkaline; clear wavy boundary.

Bk1—14 to 22 inches; light gray (2.5Y 7/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine and very fine tubular pores; disseminated carbonate throughout; violent effervescence (about 22 percent calcium carbonate equivalent); moderately alkaline; clear wavy boundary.

Bk2—22 to 28 inches; light gray (2.5Y 7/2) silt loam, light olive brown (2.5Y 5/3) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and very fine tubular pores; disseminated carbonate throughout; violent effervescence (about 23 percent calcium carbonate equivalent); moderately alkaline; clear wavy boundary.

C1—28 to 40 inches; pale yellow (2.5Y 7/4) silt loam, light olive brown (2.5Y 5/4) moist; few fine prominent yellowish red (5YR 5/8) mottles; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; common fine and very fine tubular pores; strong effervescence (about 17 percent calcium carbonate equivalent); moderately alkaline; gradual wavy boundary.

C2—40 to 50 inches; pale yellow (2.5Y 7/3) silt loam, light olive brown (2.5Y 5/4) moist; common fine prominent yellowish red (5YR 5/8) mottles; massive; very hard, friable, slightly sticky and slightly plastic; common fine and very fine tubular pores; few fine irregular soft masses of carbonate; few fine faint dark reddish brown (5YR 3/3) accumulations of iron and manganese oxide; strong effervescence (about 14 percent calcium carbonate equivalent); moderately alkaline; gradual wavy boundary.

2C3—50 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; many fine prominent yellowish red (5YR 5/8) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine irregular soft masses of carbonate; many fine faint dark reddish brown (5YR 3/3) accumulations of iron and manganese oxide; about 5 percent pebbles; strong effervescence (about 14 percent calcium carbonate equivalent); moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 0 to 7 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over loamy glacial till
Depth to gypsum and other salts: 40 to more than 60 inches

A horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly silty clay loam; silt loam in some pedons

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (3 to 5 moist)
Chroma—1 to 4
Texture—silty clay loam or silt loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—silty clay loam or silt loam

2C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

Davison Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 2 percent

Typical Pedon

Davison loam, in an area of Davison-Crossplain complex, 1,250 feet west and 2,480 feet north of the southeast corner of sec. 18, T. 113 N., R. 58 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; common very fine roots; about 2 percent pebbles; slight effervescence (about 7 percent calcium carbonate equivalent); slightly alkaline; abrupt smooth boundary.

Bk1—9 to 16 inches; light brownish gray (2.5Y 6/2)

loam, olive brown (2.5Y 4/3) moist; weak medium prismatic structure; slightly hard, very friable; common very fine roots; many fine irregular soft masses of carbonate; about 2 percent pebbles; strong effervescence (about 22 percent calcium carbonate equivalent); slightly alkaline; clear smooth boundary.

Bk2—16 to 23 inches; light yellowish brown (2.5Y 6/3) loam, olive brown (2.5Y 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; common very fine roots; many very fine tubular, common fine tubular, and few medium vesicular pores; many fine and medium irregular soft masses of carbonate; about 4 percent pebbles; violent effervescence (about 25 percent calcium carbonate equivalent); slightly alkaline; gradual smooth boundary.

Bk3—23 to 33 inches; light yellowish brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/3) moist; weak medium prismatic structure; hard, friable; few very fine roots; many very fine tubular pores; common fine and few medium irregular soft masses of carbonate; about 5 percent pebbles; violent effervescence (about 22 percent calcium carbonate equivalent); slightly alkaline; gradual wavy boundary.

C1—33 to 46 inches; light gray (2.5Y 7/2) clay loam, olive brown (2.5Y 4/3) moist; common fine prominent yellowish red (5YR 5/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; few fine vesicular and tubular pores; very few dark reddish brown (5YR 3/2) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence (about 17 percent calcium carbonate equivalent); slightly alkaline; gradual wavy boundary.

C2—46 to 60 inches; light gray (2.5Y 7/2) clay loam, olive brown (2.5Y 4/3) moist; many fine prominent yellowish red (5YR 5/8) and common reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, slightly sticky and slightly plastic; few prominent dark reddish brown (5YR 3/2) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 15 inches
Depth to carbonates: 0 to 6 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 15 to more than 60 inches

A horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; very fine sandy loam or silt loam in some pedons

Bk horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 or 5 moist)
Chroma—2 to 4
Texture—dominantly loam or clay loam; sandy loam in some pedons

C horizon:
Hue—2.5Y or 5Y
Value—5 to 8 (4 to 6 moist)
Chroma—1 to 4
Texture—stratified loam, sandy loam, fine sandy loam, silt loam, or clay loam

Delmont Series

Depth to bedrock: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Landform: Outwash plains
Parent material: Loamy alluvium over glacial outwash
Slope: 0 to 6 percent

Typical Pedon

Delmont loam, in an area of Delmont-Enet loams, 0 to 2 percent slopes, 850 feet west and 340 feet north of the southeast corner of sec. 14, T. 115 N., R. 64 W.; in Spink County, South Dakota:

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; neutral; abrupt smooth boundary.

Bw—7 to 16 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; slightly alkaline; clear wavy boundary.

2C1—16 to 22 inches; grayish brown (2.5Y 5/2) gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose; few very fine roots; 10 percent calcium carbonate equivalent; few carbonate coatings on sand and gravel; 20 percent gravel;

strongly effervescent; moderately alkaline; gradual wavy boundary.

2C2—22 to 60 inches; light olive brown (2.5Y 5/3) gravelly loamy sand, olive brown (2.5Y 4/3) moist; single grain; loose; 8 percent calcium carbonate equivalent; few carbonate coatings on sand and gravel; 25 percent gravel; strongly effervescent; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 20 inches
Depth to carbonates: 14 to 20 inches
Depth to contrasting or impervious layer: 14 to 20 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches
Other features: Some pedons have a Bk horizon.

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 to 3
Texture—dominantly loam; very fine sandy loam or silt loam in some pedons

Bw horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 to 3
Texture—dominantly loam; sandy loam or fine sandy loam in some pedons

2C horizon:
Hue—5YR to 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—gravelly sand, gravelly loamy sand, very gravelly loamy sand, or very gravelly sand

Dimo Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Landform: Flood plains
Parent material: Loamy alluvium over glacial outwash
Slope: 0 to 1 percent

Typical Pedon

Dimo loam, 1,055 feet east and 10 feet south of the northwest corner of sec. 12, T. 110 N., R. 60 W.; in Beadle County, South Dakota:

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

A—6 to 12 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; hard, friable; slightly acid; gradual smooth boundary.

Bw1—12 to 15 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

Bw2—15 to 22 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky; neutral; gradual wavy boundary.

Bk—22 to 28 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few distinct faint dark brown (10YR 3/3) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine dark concretions of iron and manganese oxide; violent effervescence; moderately alkaline; gradual wavy boundary.

2C1—28 to 38 inches; grayish brown (2.5Y 5/2) gravelly sand, dark grayish brown (2.5Y 4/2) moist; common fine prominent dark yellowish brown (10YR 4/6) mottles; single grain; loose; few fine dark concretions of iron and manganese oxide; common fine irregular soft masses of carbonate; about 25 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

2C2—38 to 60 inches; grayish brown (2.5Y 5/2) gravelly sand, dark grayish brown (2.5Y 4/2) moist; many coarse prominent strong brown (7.5YR 5/6) mottles; single grain; loose; about 25 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 40 inches
Depth to carbonates: 20 to 40 inches
Depth to contrasting or impervious layer: 20 to 40 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR or 2.5Y
Value—3 or 4 (2 or 2.5 moist)
Chroma—1 or 2
Texture—dominantly loam; clay loam, silt loam, or silty clay loam in some pedons

Bw horizon:
Hue—10YR, 2.5Y, or neutral

Value—3 to 5 (2 to 4 moist)
Chroma—0 to 2
Texture—dominantly clay loam; loam or sandy clay loam in some pedons

Bk horizon:
Hue—2.5Y or 5Y
Value—5 to 8 (4 to 6 moist)
Chroma—1 to 3
Texture—dominantly loam; gravelly loam, clay loam, sandy loam, or loamy sand in some pedons

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—gravelly sand, gravelly loamy sand, very gravelly sand, or very gravelly loamy sand

Divide Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Landform: Outwash plains
Parent material: Loamy alluvium over glacial outwash
Slope: 0 to 2 percent

Typical Pedon

Divide loam, 2,000 feet south and 500 feet east of the northwest corner of sec. 6, T. 119 N., R. 56 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium granular structure; slightly hard, very friable; common very fine roots; few very fine and fine continuous tubular pores; strong effervescence (about 7 percent calcium carbonate equivalent); slightly alkaline; abrupt smooth boundary.

Bk1—10 to 21 inches; light gray (2.5Y 7/2) loam, light yellowish brown (2.5Y 6/3) moist; weak medium prismatic structure; slightly hard, friable; common very fine roots; common very fine and fine continuous tubular pores; violent effervescence (about 29 percent calcium carbonate equivalent); moderately alkaline; clear smooth boundary.

Bk2—21 to 28 inches; pale yellow (2.5Y 8/2) loam, light brownish gray (2.5Y 6/2) moist; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; hard, friable; few very fine roots; few very fine continuous tubular pores; violent effervescence (about 35 percent calcium carbonate equivalent); moderately alkaline; gradual smooth boundary.

Bk3—28 to 37 inches; light gray (10YR 7/1) loam, gray (10YR 6/1) moist; few medium prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; hard, friable; violent effervescence (about 29 percent calcium carbonate equivalent); moderately alkaline; abrupt smooth boundary.

2C1—37 to 47 inches; light gray (2.5Y 7/2) extremely gravelly loamy sand, grayish brown (2.5Y 5/2) moist; many medium prominent yellowish brown (10YR 5/4) mottles; single grain; loose; few fine prominent very dark gray (10YR 3/1) accumulations of iron and manganese oxide; about 65 percent gravel; violent effervescence (about 18 percent calcium carbonate equivalent); moderately alkaline; gradual smooth boundary.

2C2—47 to 60 inches; light gray (5Y 7/2) extremely gravelly loamy sand, olive gray (5Y 5/2) moist; single grain; loose; few fine prominent brown (7.5YR 4/2) accumulations of iron and manganese oxide; about 65 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting or impervious layer: 20 to 40 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches
Other features: In some pedons the C horizon has less than 60 percent gravel by volume. Some pedons have a 2Bk horizon.

A horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; sandy loam, sandy clay loam, silt loam, or clay loam in some pedons

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 8 (3 to 7 moist)
Chroma—1 to 4
Texture—loam, clay loam, or sandy clay loam

2C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 6
Texture—stratified sand to gravelly sand

Dudley Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Very slow

Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 2 percent

Typical Pedon

Dudley silt loam, in an area of Dudley-Jerauld silt loams, 310 feet east and 120 feet north of the southwest corner of sec. 33, T. 113 N., R. 58 W.

A—0 to 8 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; many very fine roots and few fine roots; moderately acid; clear smooth boundary.

E—8 to 11 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium platy structure parting to weak fine granular; slightly hard, very friable; many very fine roots; many very fine tubular pores; slightly acid; clear wavy boundary.

Btn1—11 to 18 inches; dark gray (10YR 4/1) clay, very dark grayish brown (10YR 3/2) moist; moderate medium columnar structure parting to moderate and strong medium subangular blocky; extremely hard, firm, sticky and plastic; few very fine roots; common very fine roots between peds; common very fine vesicular and tubular pores; gray (10YR 5/1) continuous coatings on tops of columns; shiny films on faces of peds; about 2 percent pebbles; neutral; clear smooth boundary.

Btn2—18 to 28 inches; dark gray (10YR 4/1) clay, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to strong medium angular blocky; extremely hard, very firm, sticky and plastic; few very fine roots; common very fine roots in cracks; few very fine tubular pores; shiny films on faces of peds; about 2 percent pebbles; neutral; clear wavy boundary.

Btnz—28 to 34 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak medium prismatic structure parting to moderate medium angular blocky; extremely hard, very firm, sticky and plastic; few very fine tubular pores; shiny films on faces of peds; common fine irregular nests of salt; about 2 percent pebbles; slightly alkaline; gradual wavy boundary.

Bkz—34 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam, light olive brown (2.5Y 5/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many continuous carbonate coatings throughout; few fine nests of gypsum and other salts; about 2 percent pebbles; violent effervescence; slightly alkaline; clear smooth boundary.

Bk—42 to 50 inches; light yellowish brown (2.5Y 6/3) clay loam, olive brown (2.5Y 4/3) moist; common fine prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; very hard, firm, sticky and plastic; very few dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; common irregular soft masses of carbonate; about 6 percent pebbles; strong effervescence; moderately alkaline; clear smooth boundary.

C—50 to 60 inches; olive gray (5Y 5/2) clay loam, olive brown (2.5Y 4/3) moist; common fine prominent strong brown (7.5YR 5/8) mottles; massive; very hard, firm, slightly sticky and slightly plastic; few dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; few fine irregular carbonate concretions; about 9 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 40 inches
Depth to carbonates: 16 to 35 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 16 to 40 inches

A horizon:
- Hue—10YR
- Value—3 to 5 (2 or 3 moist)
- Chroma—1 or 2
- Texture—dominantly silt loam; loam in some pedons

E horizon:
- Hue—10YR
- Value—5 to 7 (3 to 5 moist)
- Chroma—1 or 2
- Texture—silt loam or loam

Btn horizon:
- Hue—10YR or 2.5Y
- Value—3 to 5 (2 or 3 moist)
- Chroma—1 or 2

Bk or Bkz horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—4 to 6 (3 to 5 moist)
- Chroma—2 to 4
- Texture—clay loam, silty clay loam, or clay

C horizon:
- Hue—2.5Y or 5Y
- Value—5 to 7 (4 to 6 moist)
- Chroma—2 to 4
- Texture—loam or clay loam

Durrstein Series

Depth to bedrock: Very deep
Drainage class: Poorly drained

Permeability: Very slow
Landform: Flood plains
Parent material: Clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Durrstein silt loam, 450 feet east and 2,050 feet north of the southwest corner of sec. 31, T. 110 N., R. 58 W.

E—0 to 2 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium platy structure parting to weak fine granular; slightly hard, friable; many fine and very fine roots; slightly acid; abrupt smooth boundary.

Btn1—2 to 5 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak fine and medium columnar structure parting to weak fine subangular blocky; very hard, very firm, sticky and plastic; common fine and very fine roots; coatings of gray (10YR 5/1) silty clay loam on tops and sides of columns; neutral; clear smooth boundary.

Btn2—5 to 12 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky and plastic; common fine and very fine roots; continuous faint shiny films on vertical faces of peds; slightly alkaline; clear wavy boundary.

Bz—12 to 19 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, very firm, sticky and plastic; common very fine roots; common fine irregular masses of carbonate; many fine irregular nests of salts; strong effervescence; slightly alkaline; clear wavy boundary.

Bkz1—19 to 34 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; common very fine roots; few fine irregular accumulations of iron and manganese oxide; many medium and coarse irregular accumulations of carbonate; common fine irregular nests of salts; strong effervescence; moderately alkaline; gradual wavy boundary.

Bkz2—34 to 45 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine prominent strong brown (7.5YR 5/8) mottles; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; common fine irregular accumulations of iron and manganese oxide; common medium and coarse irregular accumulations of carbonate; common fine irregular nests of salts; strong effervescence; moderately alkaline; about 8 percent pebbles; clear wavy boundary.

2Cg—45 to 60 inches; olive gray (5Y 4/2) sandy loam, dark olive gray (5Y 3/2) moist; massive; soft, very friable; 8 percent pebbles; common fine irregular accumulations of iron and manganese oxide; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 15 to 30 inches
Depth to carbonates: 5 to 15 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over sandy material
Depth to gypsum and other salts: 5 to 15 inches
Other features: Some pedons have a C horizon. Some pedons do not have a 2C horizon.

E horizon:
- Hue—10YR
- Value—5 or 6 (3 or 4 moist)
- Chroma—1 or 2
- Texture—dominantly silt loam; loam in some pedons

Btn horizon:
- Hue—10YR or 2.5Y
- Value—3 to 6 (2 to 4 moist)
- Chroma—1 or 2
- Texture—clay, clay loam, or silty clay

Bzg or Bkz horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—5 or 6 (2 to 5 moist)
- Chroma—1 or 2
- Texture—silty clay, clay loam, silty clay loam, or clay

2Cg horizon:
- Hue—2.5Y or 5Y
- Value—4 to 7 (3 to 6 moist)
- Chroma—1 or 2
- Texture—sand to fine sandy loam

Egeland Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Outwash plains and moraines
Parent material: Loamy glaciofluvial sediments
Slope: 0 to 9 percent

Typical Pedon

Egeland sandy loam, in an area of Egeland-Embden complex, 2 to 6 percent slopes, 2,500 feet south and 330 feet west of the northeast corner of sec. 25, T. 118 N., R. 58 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; common very fine and fine roots; slightly acid; abrupt smooth boundary.
Bw1—8 to 15 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common very fine and fine roots; neutral; clear wavy boundary.
Bw2—15 to 21 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable; common very fine and fine roots; neutral; clear wavy boundary.
Bk—21 to 29 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, very friable; few very fine and fine roots; common fine rounded soft masses of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.
C1—29 to 48 inches; pale brown (10YR 6/3) fine sandy loam, yellowish brown (10YR 5/4) moist; few fine distinct brownish yellow (10YR 6/6) and light yellowish brown (10YR 6/4) mottles; massive; soft, very friable; few fine rounded soft masses of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.
C2—48 to 60 inches; light yellowish brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; few fine distinct strong brown (7.5YR 5/6) mottles; massive; soft, very friable; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 16 inches
Depth to carbonates: 14 to 45 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over glacial till
Depth to gypsum and other salts: Greater than 60 inches
Other features: In some pedons, gravelly material is below a depth of 40 inches.

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly sandy loam; fine sandy loam or loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—4 to 6 (2 to 5 moist)
Chroma—1 to 4
Texture—dominantly sandy loam or fine sandy loam; loamy sand or loamy fine sand in some pedons

Bk horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 or 5 moist)
Chroma—2 to 4
Texture—dominantly fine sandy loam, sandy loam, or loamy fine sand; loamy very fine sand or loamy sand in some pedons

C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 or 5 moist)
Chroma—2 to 4
Texture—dominantly fine sandy loam, loamy sand, or loamy fine sand; sandy loam, loamy very fine sand, or very fine sandy loam in some pedons

Embden Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Loamy glaciofluvial sediments
Slope: 0 to 6 percent

Typical Pedon

Embden fine sandy loam, in an area of Egeland-Embden complex, 0 to 2 percent slopes, 1,320 feet west and 130 feet north of the southeast corner of sec. 8, T. 114 N., R. 57 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable; few very fine roots; common very fine vesicular pores; neutral; abrupt smooth boundary.
A—8 to 16 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, friable; few very fine roots; many very fine vesicular and tubular pores; neutral; gradual wavy boundary.
Bw1—16 to 22 inches; dark grayish brown (10YR 4/2) sandy loam, very dark gray (10YR 3/1) moist; weak coarse prismatic structure parting to weak fine subangular blocky parting to weak coarse subangular blocky; slightly hard, very friable; few very fine roots; common very fine vesicular and few fine vesicular and tubular pores; few faint dark gray (10YR 4/1) discontinuous coatings on faces of peds; neutral; gradual wavy boundary.
Bw2—22 to 30 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2)

moist; weak coarse prismatic structure; slightly hard, very friable; few very fine roots; common very fine vesicular and tubular and few fine and medium tubular pores; neutral; gradual wavy boundary.

Bw3—30 to 37 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; few very fine roots; common very fine and fine vesicular and tubular and few medium vesicular and tubular pores; neutral; abrupt wavy boundary.

Bk1—37 to 49 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; few fine prominent yellowish brown (10YR 5/6) and few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; few very fine roots; common very fine and fine vesicular and tubular pores; violent effervescence; slightly alkaline; gradual wavy boundary.

Bk2—49 to 53 inches; light gray (2.5Y 7/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; few fine prominent yellowish brown (10YR 5/6) and few fine distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; common very fine and fine vesicular and few fine tubular pores; strong effervescence; slightly alkaline; gradual wavy boundary.

C—53 to 60 inches; light yellowish brown (2.5Y 6/4) loamy sand, olive brown (2.5Y 4/4) moist; massive; soft, loose; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 40 inches
Depth to carbonates: 20 to 60 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over finer or coarser material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR or 2.5Y
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly loam or fine sandy loam; sandy loam, very fine sandy loam, or loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 to 4
Texture—fine sandy loam, loam, sandy loam, or very fine sandy loam

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 8 (3 to 6 moist)
Chroma—1 to 4
Texture—fine sandy loam, sandy loam, loamy fine sand, very fine sandy loam, or loamy sand

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—1 to 4
Texture—fine sandy loam, sandy loam, loamy sand, loamy fine sand, or very fine sandy loam

Enet Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Landform: Outwash plains
Parent material: Loamy alluvium over glacial outwash
Slope: 0 to 6 percent

Typical Pedon

Enet loam, 0 to 2 percent slopes, 1,550 feet north and 725 feet west of the southeast corner of sec. 32, T. 112 N., R. 60 W.; in Beadle County, South Dakota:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable; neutral; abrupt smooth boundary.

Bw1—7 to 18 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

Bw2—18 to 22 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky; neutral; gradual wavy boundary.

BC—22 to 25 inches; brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, very friable; neutral; abrupt smooth boundary.

2C1—25 to 31 inches; yellowish brown (10YR 5/4) gravelly sand, brown (10YR 4/3) moist; single grain; loose; about 28 percent gravel; slightly effervescent; slightly alkaline; gradual wavy boundary.

2C2—31 to 45 inches; brown (10YR 5/3) gravelly sand, brown (10YR 4/3) moist; single grain; loose; about 25 percent gravel; slightly effervescent; slightly

alkaline; gradual wavy boundary.

2C3—45 to 60 inches; light brownish gray (10YR 6/2) gravelly sand, dark grayish brown (10YR 4/2) moist; single grain; loose; about 30 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 40 inches
Depth to carbonates: 20 to 40 inches
Depth to contrasting or impervious layer: 20 to 40 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches
Other features: Some pedons do not have a BC horizon.

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam or fine sandy loam in some pedons

Bw horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 to 3
Texture—dominantly loam; clay loam or sandy clay loam in some pedons

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—gravelly loamy sand, gravelly sand, very gravelly loamy sand, or very gravelly sand

Ethan Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Loamy glacial till
Slope: 2 to 20 percent

Typical Pedon

Ethan loam, in an area of Clarno-Ethan-Bonilla loams, 1 to 6 percent slopes, 550 feet east and 620 feet north of the southwest corner of sec. 35, T. 113 N., R. 57 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, friable; common very fine and fine roots; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bk1—9 to 16 inches; very pale brown (10YR 7/3) loam, light olive brown (2.5Y 5/3) moist; weak medium subangular blocky structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine tubular and few fine vesicular pores; few fine irregular soft masses of carbonate and carbonate coatings on rock fragments; about 8 percent pebbles; violent effervescence; slightly alkaline; clear smooth boundary.

Bk2—16 to 30 inches; very pale brown (10YR 7/4) loam, light olive brown (2.5Y 5/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine tubular and few fine vesicular pores; common fine irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline; clear smooth boundary.

C1—30 to 45 inches; pale yellow (2.5Y 7/3) loam, light olive brown (2.5Y 5/4) moist; few fine prominent yellowish red (5YR 5/8) and strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable; few very fine roots; very few dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 5 percent pebbles; violent effervescence; slightly alkaline; gradual wavy boundary.

C2—45 to 60 inches; light yellowish brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/3) moist; common fine prominent yellowish red (5YR 5/8) and strong brown (7.5YR 5/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; very few dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 8 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 10 inches
Depth to carbonates: 0 to 5 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches

A horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—2 or 3
Texture—dominantly loam; clay loam, silt loam, gravelly loam, loamy fine sand, or sandy loam in some pedons

Bk horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (3 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 8 (4 to 6 moist)
Chroma—2 to 4
Texture—dominantly loam or clay loam; silt loam or fine sandy loam in some pedons

Fairdale Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Loamy alluvium
Slope: 0 to 1 percent

Typical Pedon

Fairdale loam, in an area of La Prairie-Fairdale loams, channeled, 222 feet south and 260 feet west of the northeast corner of sec. 5, T. 115 N., R. 59 W.

A—0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; common very fine roots; many very fine vesicular and few tubular pores; slight effervescence; slightly alkaline; clear smooth boundary.

C—8 to 14 inches; gray (10YR 5/1) sandy loam that has thin layers of fine sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; common very fine roots; common very fine vesicular and few tubular pores; slight effervescence; moderately alkaline; clear smooth boundary.

Ab—14 to 22 inches; dark gray (10YR 4/1) loam that has thin layers of fine sand, very dark gray (10YR 3/1) moist; massive; soft, very friable; common very fine roots; common very fine vesicular and few tubular pores; few medium rounded soft masses of carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C'1—22 to 25 inches; gray (10YR 5/1) loam that has thin layers of fine sand, dark grayish brown (10YR 4/2) moist; common fine prominent yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; massive; slightly hard, very friable; common very fine roots; many very fine vesicular and few very fine and fine tubular pores; few fine strata of fine sand; common medium rounded soft masses of carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C'2—25 to 35 inches; gray (10YR 6/1) loam, gray (10YR 5/1) moist; few fine prominent brownish yellow (10YR 6/6) and common prominent dark brown (10YR 3/3) mottles; massive; slightly hard, very friable; common very fine roots; common very fine vesicular and very fine and fine tubular pores; few fine strata of fine sand; common fine and medium soft masses of carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C'3—35 to 45 inches; gray (10YR 6/1) loam, gray (10YR 5/1) moist; common medium distinct very dark grayish brown (10YR 3/2) and common fine prominent brownish yellow (10YR 6/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine vesicular and very fine and fine tubular pores; few fine strata of fine sand; slight effervescence; moderately alkaline; clear smooth boundary.

2C—45 to 60 inches; light gray (10YR 7/1) sand, grayish brown (10YR 5/2) moist; single grain; loose; few fine strata of fine sand; about 1 percent pebbles; slight effervescence; moderately alkaline.

Range in Characteristics

Carbonates: At the surface
Depth to contrasting or impervious layer: 40 to more than 60 inches over sandy material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR or 2.5Y
Value—4 or 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam, clay loam, fine sandy loam, very fine sandy loam, silty clay loam, or silty clay in some pedons

C and C ' horizons:
Hue—10YR or 2.5Y
Value—4 to 7 (3 to 5 moist)
Chroma—1 to 4
Texture—stratified sand to silty clay loam

Farmsworth Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Slow
Landform: Flood plains
Parent material: Clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Farmsworth silt loam, in an area of Farmsworth-Durrstein silt loams, 1,300 feet north and 650 feet east of the southwest corner of sec. 23, T. 114 N., R. 61 W.; in Spink County, South Dakota:

A—0 to 5 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; slightly acid; clear smooth boundary.

E—5 to 8 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak thin platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; slightly acid; clear smooth boundary.

Btn1—8 to 12 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate medium columnar structure; very hard, firm, very sticky and very plastic; common very fine roots between peds; few very fine tubular pores; gray (10YR 5/1) coatings on tops of columns and gray films on vertical faces of peds; neutral; moderately alkaline; clear smooth boundary.

Btn2—12 to 19 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; moderate medium prismatic structure parting to moderate fine and medium angular blocky; very hard, very firm, very sticky and very plastic; common very fine roots between peds; few very fine tubular pores; moderately alkaline; clear wavy boundary.

Btny—19 to 25 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, firm, sticky and plastic; few very fine roots between peds; few very fine tubular pores; common fine and medium nests of gypsum and few fine salt masses; slightly alkaline; clear wavy boundary.

Bky—25 to 43 inches; gray (2.5Y 5/1) silty clay, very dark gray (2.5Y 3/1) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; common fine soft masses of carbonate; common fine and medium nests of gypsum and few fine salt masses; strong effervescence (about 5 percent calcium carbonate equivalent); moderately alkaline; gradual wavy boundary.

Akb—43 to 52 inches; dark gray (2.5Y 4/1) silty clay, very dark gray (2.5Y 2.5/1) moist; weak fine and medium subangular blocky structure; hard, friable, sticky and plastic; few very fine tubular pores; common fine and medium soft masses of carbonate; strong effervescence (about 19 percent calcium carbonate equivalent); moderately alkaline; clear wavy boundary.

Cg—52 to 60 inches; gray (2.5Y 6/1) loam, dark gray (2.5Y 4/1) moist; common fine and medium prominent dark yellowish brown (10YR 4/6) and common fine distinct gray (10YR 5/1) mottles; massive; hard, friable, sticky and plastic; few very fine tubular pores; strong effervescence (about 11 percent calcium carbonate equivalent); moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 40 inches
Depth to carbonates: 10 to 40 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 16 to 32 inches

A horizon:
- Hue—10YR
- Value—3 or 4 (2 or 3 moist)
- Chroma—1
- Texture—dominantly silt loam; clay loam, loam, or silty clay loam in some pedons

E horizon:
- Hue—10YR
- Value—5 to 7 (3 to 5 moist)
- Chroma—1 or 2
- Texture—loam, clay loam, silt loam, or silty clay loam

Btn horizon:
- Hue—10YR or 2.5Y
- Value—3 to 5 (2 to 4 moist)
- Chroma—1 or 2
- Texture—clay or silty clay

Bk or Bkz horizon:
- Hue—10YR or 2.5Y
- Value—4 to 6 (3 to 5 moist)
- Chroma—1 to 3
- Texture—clay, clay loam, or silty clay

C horizon:
- Hue—2.5Y or 5Y
- Value—5 to 7 (3 to 5 moist)
- Chroma—1 to 4
- Texture—dominantly clay or silty clay; clay loam or sandy clay loam in some pedons

Ferney Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained

Permeability: Very slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 2 percent

Typical Pedon

Ferney loam, in an area of Cavour-Ferney loams, 230 feet east and 1,200 feet south of the northwest corner of sec. 7, T. 115 N., R. 58 W.

A—0 to 4 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure parting to moderate fine and medium granular; soft, very friable; common very fine and fine roots; neutral; abrupt smooth boundary.

Btn1—4 to 9 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium columnar structure parting to strong fine and medium angular blocky; extremely hard, firm, sticky and plastic; common very fine and fine roots; gray (10YR 5/1) continuous coatings on tops of columns and shiny films on faces of peds; about 2 percent pebbles; slightly alkaline; clear smooth boundary.

Btn2—9 to 12 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm, sticky and plastic; common very fine roots; continuous shiny films on faces of peds; few fine salt masses; about 2 percent pebbles; slightly alkaline; clear wavy boundary.

Btnkz—12 to 18 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium subangular blocky structure parting to weak fine subangular blocky; very hard, very firm, sticky and plastic; few very fine roots; shiny films on faces of peds; common fine and medium masses of salt; about 2 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Bkz1—18 to 34 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to weak fine subangular blocky; very hard, firm, sticky and plastic; very few strong brown (7.5YR 5/6) patchy accumulations of iron and manganese oxide; common fine and medium soft masses of carbonate; common fine masses of salt; about 2 percent pebbles; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkz2—34 to 48 inches; light brownish gray (2.5Y 6/2) and light yellowish brown (2.5Y 6/4) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to weak fine subangular blocky; very hard, firm, slightly sticky and slightly plastic; common fine and medium iron concretions; common fine and medium soft masses of carbonate; common fine masses of salt; about 3 percent pebbles; violent effervescence; moderately alkaline; gradual wavy boundary.

C—48 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; few fine prominent strong brown (7.5YR 5/6) mottles; massive; very hard, firm, slightly sticky and slightly plastic; about 4 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 5 to 16 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 5 to 16 inches
Other features: An E horizon in some pedons

A horizon:
Hue—10YR
Value—4 or 5 (2 or 3 moist)
Chroma—1
Texture—dominantly loam; clay loam or silt loam in some pedons

Btn horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—1 to 4
Texture—clay loam or clay

Btnkz horizon:
Hue—10YR or 2.5Y
Value—3 to 6 (2 to 4 moist)
Chroma—2 to 4
Texture—clay loam or clay

Bkz horizon:
Hue—10YR or 2.5Y
Value—5 to 8 (3 to 6 moist)
Chroma—2 to 4
Texture—clay loam or clay

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 8 (3 to 6 moist)
Chroma—2 to 4
Texture—clay loam or clay

Fordville Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Landform: Outwash plains

Parent material: Loamy alluvium over glacial outwash
Slope: 0 to 6 percent

Typical Pedon

Fordville loam, 0 to 2 percent slopes (fig. 13), 2,360 feet north and 340 feet west of the southeast corner of sec. 36, T. 118 N., R. 58 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; about 2 percent pebbles; slightly acid; abrupt smooth boundary.

Bw1—7 to 17 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable; common very fine roots; about 2 percent pebbles; slightly acid; clear wavy boundary.

Bw2—17 to 24 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; common very fine roots; about 2 percent pebbles; neutral; clear wavy boundary.

BC—24 to 28 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, friable; common very fine roots; about 4 percent pebbles; neutral; clear wavy boundary.

2C1—28 to 43 inches; brown (10YR 5/3) very gravelly loamy sand, brown (10YR 4/3) moist; single grain; loose; about 50 percent gravel; carbonate coatings on the underside of pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

2C2—43 to 60 inches; light brownish gray (10YR 6/2) gravelly sand, dark grayish brown (10YR 4/2) moist; single grain; loose; carbonate coatings on the underside of pebbles; about 30 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 30 inches
Depth to carbonates: 17 to 40 inches
Depth to contrasting or impervious layer: 20 to 40 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches
Other features: Some pedons have a Bk horizon, and some pedons do not have a BC horizon.

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam in some pedons

Bw horizon:
Hue—10YR
Value—3 to 5 (2 to 4 moist)
Chroma—1 to 4
Texture—loam, silt loam, or clay loam

2C horizon:
Hue—10YR or 2.5Y
Value—4 to 7 (3 to 6 moist)
Chroma—2 to 4
Texture—dominantly sand, gravelly loamy sand, gravelly sand, or very gravelly loamy sand; loamy sand, gravelly coarse sand, or very gravelly sand in some pedons

Forman Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Loamy glacial till
Slope: 0 to 9 percent

Typical Pedon

Forman loam, in an area of Forman-Aastad loams, 1 to 6 percent slopes, 2,500 feet south and 1,130 feet east of the northwest corner of sec. 5, T. 114 N., R. 58 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable; many very fine and fine roots; common very fine and fine tubular and vesicular pores; about 1 percent pebbles; slightly alkaline; abrupt smooth boundary.

Bt—8 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to weak medium angular blocky; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine vesicular pores; shiny films on faces of peds; about 1 percent pebbles; slightly alkaline; abrupt wavy boundary.

Bk1—15 to 19 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to weak medium angular blocky; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine vesicular and tubular pores; few fine rounded soft masses of carbonate; about 1 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Bk2—19 to 31 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine vesicular and tubular pores; common fine rounded soft masses of carbonate and few carbonate threads; about 5 percent pebbles; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—31 to 42 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine prominent strong brown (7.5YR 4/6) and few fine faint gray (2.5Y 6/1) mottles; massive; hard, friable, sticky and slightly plastic; few very fine roots; few very fine vesicular and tubular pores; few fine rounded soft masses of carbonate; about 2 percent pebbles; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct gray (2.5Y 6/1) and few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, sticky and plastic; few fine roots; common very fine tubular pores; few very dark gray (10YR 3/1) accumulations of iron and manganese oxide; common fine and medium irregular salt masses; about 2 percent pebbles; violent effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 9 to 16 inches
Depth to carbonates: 10 to 24 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 moist)
Chroma—1
Texture—dominantly loam; clay loam, silt loam, or silty clay loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5 (3 or 4 moist)
Chroma—1 to 3
Texture—clay loam

Bk horizon:
Hue—2.5Y
Value—6 (5 moist)
Chroma—4
Texture—clay loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay loam or loam

Hamerly Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 3 percent

Typical Pedon

Hamerly loam, in an area of Hamerly-Tonka complex, 190 feet north and 620 feet west of the southeast corner of sec. 14, T. 115 N., R. 58 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate medium and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; about 2 percent pebbles; slight effervescence; slightly alkaline; abrupt smooth boundary.

A—6 to 10 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate medium granular; hard, firm, slightly sticky and slightly plastic; many very fine roots; coatings of carbonate on faces of peds; about 2 percent pebbles; slight effervescence (about 8 percent calcium carbonate equivalent); slightly alkaline; clear wavy boundary.

Bk1—10 to 20 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; common very fine roots; common fine and very fine vesicular and tubular pores; common fine accumulations of carbonate; about 4 percent pebbles; violent effervescence (about 19 percent calcium carbonate equivalent); moderately alkaline; gradual wavy boundary.

Bk2—20 to 27 inches; light gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/4) moist; few fine prominent brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few very fine roots; common fine and very fine vesicular and tubular pores; common fine accumulations of carbonate; about 4 percent pebbles; strong effervescence (about 30 percent calcium carbonate equivalent); moderately alkaline; gradual wavy boundary.

C1—27 to 40 inches; pale yellow (2.5Y 7/4) loam, light olive brown (2.5Y 5/4) moist; few fine prominent brownish yellow (10YR 6/6) and light gray (10YR 7/1) mottles; massive; very hard, very firm; few fine accumulations of carbonate; about 5 percent pebbles; strong effervescence (about 13 percent calcium carbonate equivalent); moderately alkaline; gradual wavy boundary.

C2—40 to 60 inches; pale yellow (2.5Y 7/4) loam, light olive brown (2.5Y 5/4) moist; common fine prominent brownish yellow (10YR 6/6) and light gray (10YR 7/1) mottles; massive; very hard, very firm; few fine nests of gypsum; about 5 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Depth to carbonates: 0 to 6 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches
Other features: An ABk horizon in some pedons

A horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam or clay loam in some pedons

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 8 (3 to 7 moist)
Chroma—1 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 8 (4 to 6 moist)
Chroma—1 to 4
Texture—loam or clay loam

Harriet Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Flood plains
Parent material: Clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Harriet loam, 900 feet south and 350 feet west of the northeast corner of sec. 33, T. 115 N., R. 59 W.

E—0 to 4 inches; gray (10YR 5/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; many fine roots; neutral; abrupt smooth boundary.

Btn—4 to 10 inches; dark grayish brown (10YR 4/2) clay loam, very dark gray (10YR 3/1) moist; moderate coarse columnar structure parting to moderate medium subangular blocky; extremely hard, firm, sticky and plastic; common very fine and fine roots in cracks and few very fine roots throughout; few very fine vesicular and tubular pores; shiny films on faces of peds; slightly alkaline; clear smooth boundary.

Btnz—10 to 17 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky parting to moderate medium angular blocky; extremely hard, very firm, sticky and plastic; common very fine and fine roots in cracks and few very fine roots throughout; few very fine vesicular and tubular pores; shiny films on faces of peds; many fine masses of salt; slight effervescence; slightly alkaline; clear wavy boundary.

Bkz1—17 to 26 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; extremely hard, firm, sticky and plastic; few fine irregular soft masses of carbonate; many fine gypsum crystals and other salts; strong effervescence; moderately alkaline; gradual wavy boundary.

Bkz2—26 to 43 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure parting to moderate fine angular blocky; very hard, friable, sticky and plastic; few fine irregular carbonate concretions and common medium irregular soft masses of carbonate; many fine gypsum crystals and other salts; strong effervescence; moderately alkaline; gradual wavy boundary.

Cz—43 to 50 inches; light olive gray (5Y 6/2) clay loam, olive gray (5Y 4/2) moist; few medium distinct very dark gray (5Y 3/1) and common prominent strong brown (7.5YR 5/8) mottles; massive; very hard, friable, sticky and plastic; few fine irregular soft masses of carbonate; few fine gypsum crystals and other salts; slight effervescence; moderately alkaline; gradual wavy boundary.

C—50 to 60 inches; pale olive (5Y 6/3) clay loam, dark gray (5Y 4/1) moist; common fine and medium faint very dark gray (5Y 3/1) and common prominent reddish yellow (7.5YR 6/8) mottles; massive; very hard, friable, sticky and plastic; many fine irregular concretions of iron and manganese oxide; common

fine and medium irregular soft masses of carbonate; about 5 percent pebbles; slight effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 14 to 26 inches
Depth to carbonates: 0 to 11 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 0 to 11 inches
Other features: A Bkg horizon in some pedons

E horizon:
Hue—10YR, 2.5Y, or neutral
Value—4 to 7 (2 to 5 moist)
Chroma—0 or 1
Texture—dominantly loam; silt loam or very fine sandy loam in some pedons

Btn horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 5 (2 to 4 moist)
Chroma—0 to 2
Texture—dominantly clay loam or silty clay loam; silty clay or clay in some pedons

C horizon:
Hue—10YR, 2.5Y, 5Y, or 5GY
Value—4 to 7 (3 to 5 moist)
Chroma—1 to 4
Texture—dominantly clay, silty clay, or clay loam; stratified very fine sandy loam to silty clay in some pedons

Heil Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Heil silt loam, 180 feet east and 280 feet south of the northwest corner of sec. 28, T. 116 N., R. 59 W.

A—0 to 2 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; soft, friable; many very fine roots; slightly acid; clear smooth boundary.

E—2 to 4 inches; gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) moist; weak thin platy structure; slightly hard, very friable; many very fine roots; common very fine tubular pores; slightly acid; clear wavy boundary.

Btn1—4 to 8 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium columnar structure; extremely hard, firm, sticky and plastic; common very fine roots in cracks and many very fine roots in a mat at the top of the horizon; common very fine vesicular and tubular pores; common gray (10YR 5/1) coatings on tops of columns; many shiny films on faces of peds; slightly acid; gradual smooth boundary.

Btn2—8 to 18 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, firm, sticky and plastic; common very fine roots; few very fine vesicular and tubular pores; neutral; gradual smooth boundary.

Btn3—18 to 30 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common very fine roots; few very fine vesicular and tubular pores; many shiny films on faces of peds; neutral; gradual wavy boundary.

Byg—30 to 40 inches; gray (5Y 6/1) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few very fine vesicular and tubular pores; few black (5YR 2.5/1) accumulations of iron and manganese oxide; common fine gypsum crystals; neutral; clear smooth boundary.

Cg1—40 to 58 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; common fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few very dark gray (5YR 3/1) accumulations of iron and manganese oxide; few fine masses of gypsum; about 5 percent pebbles; strong effervescence; slightly alkaline; gradual smooth boundary.

Cg2—58 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/3) moist; common fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; few very dark gray (5YR 3/1) accumulations of iron and manganese oxide; about 5 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 40 inches
Depth to carbonates: 12 to 40 inches
Depth to contrasting or impervious layer: Greater than 60 inches

Depth to gypsum and other salts: 20 to more than 60 inches

E horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—4 to 8 (2 to 5 moist)
- Chroma—1 or 2
- Texture—dominantly silt loam; silty clay loam or silty clay in some pedons

Btn horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—4 to 6 (2 to 4 moist)
- Chroma—1 or 2
- Texture—dominantly silty clay or clay; clay loam in some pedons

Byg or Bg horizon:
- Hue—5Y
- Value—4 to 7 (3 to 5 moist)
- Chroma—1 to 3
- Texture—dominantly clay loam or silty clay; clay, silty clay loam, or loam in some pedons

Cg horizon:
- Hue—2.5Y or 5Y
- Value—5 to 7 (3 to 5 moist)
- Chroma—1 to 4
- Texture—dominantly clay loam, loam, or silty clay; clay or silty clay loam in some pedons

Henkin Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Loamy glaciofluvial sediments
Slope: 2 to 6 percent

Typical Pedon

Henkin fine sandy loam, in an area of Henkin-Blendon fine sandy loams, 2 to 6 percent slopes, 1,910 feet south and 2,350 feet west of the northeast corner of sec. 5, T. 110 N., R. 57 W.; in Kingsbury County, South Dakota:

A—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable; common fine and very fine roots; slightly acid; clear smooth boundary.

Bw1—8 to 17 inches; brown (10YR 4/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak fine subangular blocky; soft, very friable; common fine and very fine roots; neutral; clear smooth boundary.

Bw2—17 to 26 inches; brown (10YR 5/3) sandy loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak fine subangular blocky; soft, very friable; few fine and very fine roots; neutral; clear smooth boundary.

Bk—26 to 38 inches; light yellowish brown (2.5Y 6/3) sandy loam, light olive brown (2.5Y 5/3) moist; weak coarse subangular blocky structure; soft, very friable; few fine and very fine roots; few medium masses of carbonate; violent effervescence; moderately alkaline; gradual wavy boundary.

C—38 to 60 inches; light yellowish brown (2.5Y 6/3) loamy fine sand, light olive brown (2.5Y 5/3) moist; massive; soft, very friable; few fine and very fine roots; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 20 inches
Depth to carbonates: 18 to 60 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over glacial till or gravelly material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
- Hue—10YR
- Value—3 or 4 (2 or 3 moist)
- Chroma—1 or 2
- Texture—dominantly fine sandy loam; loam or sandy loam in some pedons

Bw horizon:
- Hue—10YR or 2.5Y
- Value—4 to 6 (3 to 5 moist)
- Chroma—2 or 3
- Texture—dominantly sandy loam or fine sandy loam; loam in some pedons

Bk horizon:
- Hue—10YR or 2.5Y
- Value—5 to 7 (4 to 6 moist)
- Chroma—2 to 4
- Texture—dominantly fine sandy loam, sandy loam, or loam; loamy fine sand or loamy sand in some pedons

C horizon:
- Hue—10YR or 2.5Y
- Value—5 to 7 (4 to 6 moist)
- Chroma—2 to 4
- Texture—fine sand, loamy fine sand, fine sandy loam, or clay loam

Hetland Series

Depth to bedrock: Very deep
Drainage class: Well drained

Permeability: Slow
Landform: Ice-walled lake plains
Parent material: Clayey glaciolacustrine sediments
Slope: 0 to 6 percent

Typical Pedon

Hetland silty clay loam, 0 to 2 percent slopes, 995 feet west and 210 feet north of the southeast corner of sec. 36, T. 116 N., R. 57 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; moderately acid; abrupt smooth boundary.

Bt1—10 to 16 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; shiny films on faces of peds; neutral; gradual smooth boundary.

Bt2—16 to 23 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; very few distinct very dark gray (10YR 3/1) discontinuous organic coatings on vertical faces of peds; shiny films on faces of peds; neutral; gradual wavy boundary.

Bk1—23 to 35 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; few very fine and fine roots; common very fine and fine tubular pores; common fine and medium irregular soft masses of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk2—35 to 43 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine and fine roots; common very fine and fine tubular pores; common fine and medium irregular soft masses of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C—43 to 60 inches; light brownish gray (2.5Y 6/2) silt loam, brown (10YR 5/3) moist; common fine strong brown (7.5YR 5/8) mottles; massive; varved; hard, firm, sticky and plastic; few very fine and fine roots; few fine rounded carbonate concretions; moderately alkaline; strong effervescence.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 26 inches
Depth to carbonates: 16 to 32 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly silty clay loam; silty clay in some pedons

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 6 (2 to 5 moist)
Chroma—1 to 3
Texture—silty clay or silty clay loam

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—1 to 4
Texture—silty clay or silty clay loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—1 to 4
Texture—dominantly silty clay loam or silt loam; distinctly laminated or contains thin strata of coarser material in some pedons

Holmquist Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Loamy alluvium
Slope: 0 to 1 percent

Typical Pedon

Holmquist loam, in an area of La Prairie-Holmquist loams, channeled, 2,530 feet north and 1,050 feet east of the southwest corner of sec. 6, T. 114 N., R. 59 W.

A—0 to 2 inches; dark gray (10YR 4/1) loam that has thin layers of fine sandy loam, black (10YR 2/1) moist; weak medium platy structure parting to weak fine granular; slightly hard, very friable; many very fine and fine roots; strong effervescence; slightly alkaline; clear smooth boundary.

Az—2 to 10 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; many very fine and fine roots; common fine carbonate threads; common fine salt masses; strong effervescence; slightly alkaline; clear smooth boundary.

Cz—10 to 12 inches; gray (10YR 5/1) loam that has thin layers of fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; common very fine and fine roots; common very fine tubular pores; common fine soft masses of carbonate; common fine salt masses; violent effervescence; slightly alkaline; clear smooth boundary.

C1—12 to 18 inches; grayish brown (10YR 5/2) loam that has thin layers of fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; common very fine roots; common very fine tubular pores; strong effervescence; slightly alkaline; gradual smooth boundary.

C2—18 to 26 inches; gray (10YR 5/1) sandy loam, dark grayish brown (10YR 4/2) moist; massive; loose; common very fine roots; strong effervescence; slightly alkaline; clear smooth boundary.

C3—26 to 35 inches; gray (10YR 5/1) loam, dark grayish brown (10YR 4/2) moist; common fine prominent strong brown (7.5YR 5/8) mottles; massive; hard, very friable; strong effervescence; gradual smooth boundary.

Cg1—35 to 45 inches; gray (5Y 5/1) sandy loam, dark gray (5Y 4/1) moist; common fine prominent strong brown (7.5YR 5/8) mottles; massive; hard, very friable; strong effervescence; gradual smooth boundary.

Cg2—45 to 60 inches; gray (5Y 5/1) clay loam, dark gray (5Y 4/1) moist; common fine prominent strong brown (7.5YR 5/8) mottles; massive; very hard, firm, slightly sticky and slightly plastic; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to carbonates: 0 to 10 inches

Depth to contrasting or impervious layer: Greater than 60 inches

Depth to gypsum and other salts: 0 to 11 inches

A horizon:
- Hue—10YR or 2.5Y
- Value—3 to 5 (2 or 3 moist)
- Chroma—1 to 3
- Texture—dominantly loam; fine sandy loam or sandy loam in some pedons

C horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—3 to 7 (2.5 to 5 moist)
- Chroma—1 to 4
- Texture—stratified fine sandy loam to clay loam

Houdek Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Loamy glacial till
Slope: 0 to 9 percent

Typical Pedon

Houdek loam, in an area of Houdek-Stickney-Tetonka complex, 810 feet north and 1,290 feet east of the southwest corner of sec. 34, T. 113 N., R. 58 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; common very fine roots; about 2 percent pebbles; slightly acid; abrupt smooth boundary.

Bt—8 to 17 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and slightly plastic; common very fine roots; common very fine and fine vesicular and tubular pores; continuous shiny films on faces of peds and in pores; about 2 percent pebbles; neutral; clear smooth boundary.

Bk1—17 to 26 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, slightly sticky and slightly plastic; few very fine roots; common fine vesicular and tubular and few medium tubular pores; common fine and medium irregular soft masses of carbonate; about 4 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Bk2—26 to 32 inches; light yellowish brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/3) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; few medium and common fine irregular soft masses of carbonate; about 4 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Bk3—32 to 42 inches; light yellowish brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/3) moist; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine

tubular pores; few fine and medium irregular soft masses of carbonate; about 4 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Cy—42 to 60 inches; light brownish gray (2.5Y 6/2) loam, light olive brown (2.5Y 5/3) moist; few fine distinct pale yellow (2.5Y 7/4) mottles; massive; hard, firm, slightly sticky and slightly plastic; few medium irregular soft masses of carbonate; common fine and medium irregular nests of gypsum; about 8 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 8 to 20 inches
Depth to carbonates: 14 to 24 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches

A horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam or clay loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y
Value—4 to 6 (3 to 5 moist)
Chroma—2 or 3
Texture—clay loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 6 (4 or 5 moist)
Chroma—2 to 4
Texture—clay loam or loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

Hoven Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Hoven silt loam, 2,600 feet south and 1,100 feet west of the northeast corner of sec. 34, T. 114 N., R. 59 W.

E—0 to 2 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak thin platy structure; soft, friable; many very fine roots; few very fine vesicular and tubular pores; slightly acid; abrupt wavy boundary.

Btn1—2 to 5 inches; dark gray (10YR 4/1) silty clay, black (2.5Y 2.5/1) moist; moderate medium columnar structure parting to moderate medium subangular blocky; extremely hard, firm, very sticky and very plastic; common very fine roots; few shiny films on faces of peds; few very fine vesicular and tubular pores; few faint gray (10YR 6/1) continuous coatings on tops of columns; neutral; clear wavy boundary.

Btn2—5 to 10 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, firm, very sticky and very plastic; few very fine roots; few shiny films on faces of peds; few very fine vesicular and tubular pores; slightly alkaline; gradual smooth boundary.

Btnz1—10 to 19 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky and very plastic; few very fine roots; few shiny films on faces of peds; few very fine vesicular pores; few fine salt masses; slightly alkaline; gradual smooth boundary.

Btnz2—19 to 33 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; strong medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky and very plastic; few very fine roots; few shiny films on faces of peds; few very fine vesicular and tubular pores; few fine irregular salt masses; slightly alkaline; gradual wavy boundary.

Bkzg—33 to 40 inches; light gray (5Y 7/2) silty clay loam, olive gray (5Y 5/2) moist; few fine prominent yellowish brown (10YR 5/8) mottles; weak medium prismatic structure; very hard, friable; common very fine vesicular and tubular pores; common medium and coarse irregular soft masses of carbonate; common thin platelike salt masses; violent effervescence; moderately alkaline; clear wavy boundary.

Bzg—40 to 50 inches; gray (5Y 6/1) silty clay, gray (5Y 5/1) moist; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium prismatic structure; very hard, firm, sticky and plastic; common very fine vesicular and tubular pores; few fine irregular soft masses of carbonate; common

fine and medium rounded masses of gypsum and other salts; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cg—50 to 60 inches; light olive gray (5Y 6/2) clay loam, olive gray (5Y 5/2) moist; common fine prominent yellowish brown (10YR 5/6) mottles; massive; extremely hard, firm, slightly sticky and slightly plastic; few very fine vesicular and tubular pores; few fine irregular carbonate threads; common fine and medium irregular nests of gypsum and other salts; about 2 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 52 inches
Depth to carbonates: 7 to 32 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 15 to 60 inches

E horizon:
Hue—10YR
Value—5 to 7 (2 to 4 moist)
Chroma—1 or 2
Texture—dominantly silt loam; silty clay loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y
Value—4 or 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly clay or silty clay; clay loam or silty clay loam in some pedons

Bk or Bz horizon:
Hue—10YR or 2.5Y
Value—4 to 6 (3 or 4 moist)
Chroma—1 or 2
Texture—silty clay loam, clay loam, or silty clay

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 7 (3 to 5 moist)
Chroma—1 to 3
Texture—clay, silty clay, clay loam, or silty clay loam

Jerauld Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 2 percent

Typical Pedon

Jerauld silt loam, in an area of Dudley-Jerauld silt loams, 2,010 feet west and 70 feet south of the northeast corner of sec. 31, T. 113 N., R. 58 W.

E—0 to 3 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak thin platy structure parting to weak fine granular; soft, very friable; many very fine and fine roots; common very fine and fine vesicular and tubular pores; neutral; clear wavy boundary.

Btn—3 to 8 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; moderate medium columnar structure parting to moderate medium subangular blocky; extremely hard, firm, sticky and plastic; many very fine and fine roots in mat at the top of the horizon and common very fine roots in cracks and between peds; common very fine and fine tubular pores; gray (10YR 5/1) coatings on tops of columns; many shiny films on faces of peds; about 2 percent pebbles; neutral; clear smooth boundary.

Btnz—8 to 13 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, firm, sticky and plastic; common very fine roots in cracks and common very fine and fine roots between peds; few very fine tubular pores; many shiny films on faces of peds; common fine and medium salt masses; about 2 percent pebbles; moderately alkaline; clear smooth boundary.

Bkz1—13 to 20 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; extremely hard, friable, sticky and plastic; few very fine roots; few very fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; common fine gypsum crystals and other salts; about 2 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

Bkz2—20 to 31 inches; light olive brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; moderate medium prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and plastic; few very fine roots; few very fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; common fine gypsum crystals and other salts; about 2 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

Cz1—31 to 36 inches; light yellowish brown (2.5Y 6/3) silty clay, light olive brown (2.5Y 5/3) moist; massive; very hard, firm, sticky and plastic; few fine

irregular soft masses of carbonate; few fine gypsum crystals and other salts; about 5 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

Cz2—36 to 42 inches; light gray (2.5Y 7/2) clay loam, olive gray (5Y 4/2) moist; massive; very hard, firm, sticky and plastic; common fine and medium irregular nests of gypsum and other salts; about 5 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C—42 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine and few medium prominent yellowish red (5YR 5/8) mottles; massive; very hard, very firm, sticky and plastic; few fine irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 27 inches
Depth to carbonates: 6 to 17 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 1 to 16 inches
Other features: An A horizon in some pedons

E horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (3 to 5 moist)
Chroma—1 or 2
Texture—dominantly silt loam; silty clay loam, loam, or silty clay in some pedons

Btn horizon:
Hue—10YR or 2.5Y
Value—4 or 5 (2 or 3 moist)
Chroma—1 or 2
Texture—clay loam, clay, or silty clay

Bkz horizon:
Hue—10YR or 2.5Y
Value—4 to 6 (3 to 5 moist)
Chroma—1 to 3
Texture—silty clay, clay, or clay loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—1 to 4
Texture—silty clay loam, clay loam, silty clay, or clay

Kranzburg Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Loess or silty glacial till over loamy glacial till
Slope: 2 to 6 percent

Typical Pedon

Kranzburg silt loam (fig. 14), in an area of Kranzburg-Buse-Waubay complex, 1 to 6 percent slopes, 1,163 feet south and 280 feet east of the northwest corner of sec. 18, T. 118 N., R. 56 W.

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

Bw1—7 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; slightly alkaline; gradual smooth boundary.

Bw2—12 to 20 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common fine and very fine tubular pores; neutral; clear wavy boundary.

Bk1—20 to 30 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many fine and very fine tubular pores; common medium soft masses of carbonate; violent effervescence; moderately alkaline; clear wavy boundary.

2Bk2—30 to 37 inches; light gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/4) moist; common medium distinct light gray (N 7/0) mottles; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many fine and very fine tubular pores; common medium soft masses of carbonate; about 2 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

2C—37 to 60 inches; pale yellow (2.5Y 7/4) clay loam, olive brown (2.5Y 4/4) moist; common medium prominent light gray (N 7/0) mottles; massive; hard, friable, sticky and slightly plastic; about 4 percent pebbles; violent effervescence; strongly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Depth to carbonates: 19 to 32 inches
Depth to contrasting or impervious layer: 20 to 40 inches over loamy glacial till
Depth to gypsum and other salts: Greater than 60 inches
Other features: Some pedons do not have a Bk horizon.

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly silt loam; silty clay loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 to 4 moist)
Chroma—2 or 3
Texture—dominantly silty clay loam; silt loam in some pedons

2Bk horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay loam or loam

LaDelle Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Silty alluvium
Slope: 0 to 2 percent

Typical Pedon

LaDelle silt loam, 925 feet south and 775 feet west of the northeast corner of sec. 18, T. 117 N., R. 59 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; moderate fine granular structure; slightly hard, very friable; few very fine roots; common very fine vesicular and few tubular pores; slight effervescence; neutral; abrupt smooth boundary.

A—8 to 19 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak medium subangular blocky structure; slightly hard, very friable; many very fine roots; common very fine vesicular and few tubular pores; slight effervescence; neutral; clear smooth boundary.

Bk—19 to 27 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine vesicular and few tubular pores; many fine rounded soft masses of carbonate; violent effervescence; slightly alkaline; clear wavy boundary.

Akb—27 to 40 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky and plastic; few very fine roots; many very fine vesicular and few tubular pores; common fine and medium irregular soft masses of carbonate; slight effervescence; slightly alkaline; gradual smooth boundary.

C—40 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 17 to 50 inches
Depth to carbonates: 0 to more than 60 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 20 to more than 60 inches

A horizon:
Hue—10YR or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silt loam; silty clay loam or loam in some pedons

Bk horizon:
Hue—10YR or 2.5Y
Value—3 to 6 (2 to 5 moist)
Chroma—1 to 3
Texture—silt loam, silty clay loam, or loam

C horizon:
Hue—10YR or 2.5Y
Value—3 to 7 (2 to 5 moist)
Chroma—1 to 4
Texture—stratified silt loam to clay loam

Lamo Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained

Permeability: Moderately slow
Landform: Flood plains
Parent material: Silty alluvium
Slope: 0 to 1 percent

Typical Pedon

Lamo silty clay loam, 2,200 feet south and 970 feet east of the northwest corner of sec. 8, T. 113 N., R. 58 W.

A1—0 to 5 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; many very fine roots; slightly alkaline; clear smooth boundary.

A2—5 to 17 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure; slightly hard, very friable; common very fine roots; common very fine tubular pores; slight effervescence; slightly alkaline; clear smooth boundary.

A3—17 to 24 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium prismatic structure parting to weak fine granular; slightly hard, very friable; common very fine roots; many very fine tubular pores; common fine irregular soft masses of carbonate; strong effervescence; slightly alkaline; clear smooth boundary.

AC—24 to 32 inches; gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; many continuous carbonate coatings; violent effervescence; slightly alkaline; gradual wavy boundary.

Ab—32 to 37 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; many fine irregular soft masses of carbonate; violent effervescence; slightly alkaline; gradual smooth boundary.

C1—37 to 52 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; many continuous carbonate coatings; few dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; common fine irregular soft masses of carbonate; violent effervescence; slightly alkaline; gradual smooth boundary.

C2—52 to 60 inches; light gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; massive; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; common fine snail shells; very few dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; many continuous carbonate coatings; common fine irregular soft masses of carbonate; violent effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 39 inches
Depth to carbonates: 5 to 10 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 30 to more than 60 inches

A horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly silty clay loam; silt loam or loam in some pedons

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 7 (3 to 6 moist)
Chroma—1 or 2
Texture—silt loam or silty clay loam

Langhei Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Moraines
Parent material: Loamy glacial till
Slope: 25 to 40 percent

Typical Pedon

Langhei clay loam (fig. 15), in an area of Buse-Langhei complex, 15 to 40 percent slopes, 900 feet south and 1,500 feet west of the northeast corner of sec. 17, T. 118 N., R. 56 W.

A—0 to 3 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; about 4 percent pebbles; slight effervescence; slightly alkaline; abrupt wavy boundary.

AC—3 to 7 inches; light brownish gray (2.5Y 6/2) clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine vesicular and tubular pores; about 3 percent

pebbles; strong effervescence; slightly alkaline; clear wavy boundary.

C1—7 to 25 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine vesicular and tubular pores; few fine rounded soft masses of carbonate; about 3 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—25 to 54 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; common medium prominent yellowish red (5YR 4/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine rounded soft masses of carbonate; about 5 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—54 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) moist; common medium prominent reddish yellow (7.5YR 6/6) and few fine prominent light gray (10YR 7/1) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine rounded soft masses of carbonate; about 4 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 5 inches

Depth to contrasting or impervious layer: Greater than 60 inches

Depth to gypsum and other salts: Greater than 60 inches

A horizon:
- Hue—10YR or 2.5Y
- Value—5 to 7 (3 to 5 moist)
- Chroma—1 or 2
- Texture—dominantly clay loam; loam in some pedons

C horizon:
- Hue—10YR or 2.5Y
- Value—5 to 8 (4 to 7 moist)
- Chroma—2 to 4
- Texture—loam or clay loam

La Prairie Series

Depth to bedrock: Very deep

Drainage class: Moderately well drained

Permeability: Moderate

Landform: Flood plains

Parent material: Loamy alluvium

Slope: 0 to 2 percent

Typical Pedon

La Prairie loam, 1,040 feet east and 625 feet north of the southwest corner of sec. 2, T. 113 N., R. 58 W.

A1—0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium and thick platy structure parting to moderate fine and medium granular; hard, very friable; many very fine and fine roots; slightly alkaline; gradual wavy boundary.

A2—8 to 18 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium and coarse prismatic structure parting to weak fine and medium subangular blocky; hard, very friable; few very fine and fine roots; few very fine soft masses of carbonate; slight effervescence; slightly alkaline; abrupt wavy boundary.

Bw1—18 to 25 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak medium and coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable; few very fine and fine roots; common fine soft masses of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

Bw2—25 to 30 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium and coarse prismatic structure; slightly hard, very friable; few very fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk—30 to 50 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; weak medium and coarse prismatic structure parting to weak fine and medium subangular blocky; hard, very friable; few very fine roots; common fine soft masses of carbonate; violent effervescence; moderately alkaline; abrupt wavy boundary.

Ab—50 to 55 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak very fine and fine granular structure; hard, very friable; few very fine roots; common fine soft masses of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

Bkb—55 to 60 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, very friable; few very fine roots; common fine soft masses of carbonate; violent effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 50 inches

Depth to carbonates: 0 to 40 inches

Depth to contrasting or impervious layer: 40 to more than 60 inches over clayey or sandy material

Depth to gypsum and other salts: Greater than 60 inches

Other features: Some pedons do not have a Bk horizon, and some pedons have a C horizon.

A horizon:
Hue—10YR or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly loam; silt loam, clay loam, or silty clay loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 to 3
Texture—loam, clay loam, silt loam, or silty clay loam

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 7 (2 to 4 moist)
Chroma—1 to 3
Texture—dominantly silt loam or loam; stratified fine sandy loam to silty clay loam in some pedons

Lowe Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Loamy alluvium
Slope: 0 to 1 percent

Typical Pedon

Lowe loam, 2,880 feet south and 280 feet west of the northeast corner of sec. 13, T. 117 N., R. 58 W.

A—0 to 10 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine and fine vesicular pores; violent effervescence (about 36 percent calcium carbonate equivalent); slightly alkaline; clear smooth boundary.

Bk1—10 to 18 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine vesicular pores; many fine rounded soft masses of carbonate; violent effervescence (about 45 percent calcium carbonate equivalent); moderately alkaline; clear smooth boundary.

Bk2—18 to 34 inches; gray (10YR 6/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine vesicular and common very fine and fine tubular pores; many fine rounded soft masses of carbonate; violent effervescence (about 45 percent calcium carbonate equivalent); slightly alkaline; gradual wavy boundary.

Cg1—34 to 56 inches; light gray (5Y 7/1) silt loam, olive gray (5Y 5/2) moist; common fine prominent strong brown (7.5YR 5/8) mottles; massive; slightly hard, very friable; few very fine roots; many very fine vesicular and tubular pores; strong effervescence (about 9 percent calcium carbonate equivalent); slightly alkaline; clear wavy boundary.

2Cg2—56 to 60 inches; light gray (5Y 7/1) gravelly loam, gray (5Y 6/1) moist; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable; about 20 percent gravel; strong effervescence (about 9 percent calcium carbonate equivalent); slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 36 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over gravelly material
Depth to gypsum and other salts: 29 to more than 60 inches
Other features: An Akb horizon in some pedons

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly loam; clay loam, silt loam, or silty clay loam in some pedons

Bk horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 7 (2 to 5 moist)
Chroma—0 to 2
Texture—dominantly loam or clay loam; silt loam in some pedons

C horizon:
Hue—2.5Y or 5Y
Value—4 to 7 (3 to 6 moist)
Chroma—1 to 3
Texture—silt loam, loam, clay loam, sandy clay loam, silty clay loam, or loamy sand; stratified in some pedons; gravelly loam below a depth of 56 inches

Ludden Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Slow

Landform: Flood plains
Parent material: Clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Ludden silty clay, saline, 775 feet north and 600 feet east of the southwest corner of sec. 32, T. 118 N., R. 59 W.

Az—0 to 8 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; weak fine granular structure; very hard, friable, sticky and plastic; few very fine roots; few very fine vesicular and tubular pores; many fine masses of salt; violent effervescence; slightly alkaline; clear smooth boundary.

Bzg1—8 to 20 inches; dark gray (5Y 4/1) silty clay, black (5Y 2.5/1) moist; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; common fine masses of salt; violent effervescence; moderately alkaline; clear wavy boundary.

Bzg2—20 to 31 inches; very dark gray (5Y 3/1) silty clay, black (5Y 2.5/1) moist; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few fine and medium gypsum crystals and other salts; strong effervescence; moderately alkaline; gradual wavy boundary.

Cyg1—31 to 41 inches; gray (5Y 5/1) silty clay, dark gray (5Y 4/1) moist; many medium prominent light yellowish brown (2.5Y 6/4) and many medium faint gray (5Y 6/1) mottles; massive; very hard, firm, sticky and plastic; common fine and medium gypsum crystals; strong effervescence; moderately alkaline; clear wavy boundary.

2Cyg2—41 to 60 inches; gray (5Y 5/1) clay loam, dark gray (5Y 4/1) moist; few fine prominent strong brown (7.5YR 5/6), many fine medium faint gray (5Y 6/1), and common fine prominent light yellowish brown (2.5Y 6/4) mottles; massive; very hard, friable, slightly sticky and slightly plastic; many gypsum crystals; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 48 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 0 to 10 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silty clay; clay or silty clay loam in some pedons

B horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 to 6 (2 to 4 moist)
Chroma—0 to 2
Texture—clay, silty clay, or silty clay loam

Cg horizon:
Hue—2.5Y, 5Y, or neutral
Value—3 to 6 (2 to 5 moist)
Chroma—0 to 2
Texture—clay, silty clay, or clay loam

Maddock Series

Depth to bedrock: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Sandy glaciofluvial sediments
Slope: 2 to 9 percent

Typical Pedon

Maddock sandy loam, in an area of Maddock-Egeland sandy loams, 6 to 9 percent slopes, 1,050 feet south and 1,400 feet west of the northeast corner of sec. 11, T. 116 N., R. 57 W.

A—0 to 8 inches; dark gray (10YR 4/1) sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; few very fine roots; slightly alkaline; clear smooth boundary.

Bw—8 to 16 inches; brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate coarse subangular blocky; soft, very friable; few fine and very fine tubular pores; slightly alkaline; clear smooth boundary.

BC—16 to 24 inches; light brownish gray (10YR 6/2) loamy fine sand, brown (10YR 5/3) moist; weak coarse subangular blocky structure; soft, very friable; few very fine roots; few fine and very fine tubular pores; strong effervescence; slightly alkaline; gradual wavy boundary.

C1—24 to 42 inches; light gray (2.5Y 7/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; single grain; loose; few very fine roots; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—42 to 60 inches; light brownish gray (2.5Y 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, very friable; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches

Figure 13.—Profile of Fordville loam, 0 to 2 percent slopes, which has gravelly material at a depth of 2 to 3 feet. Depth is marked in feet.

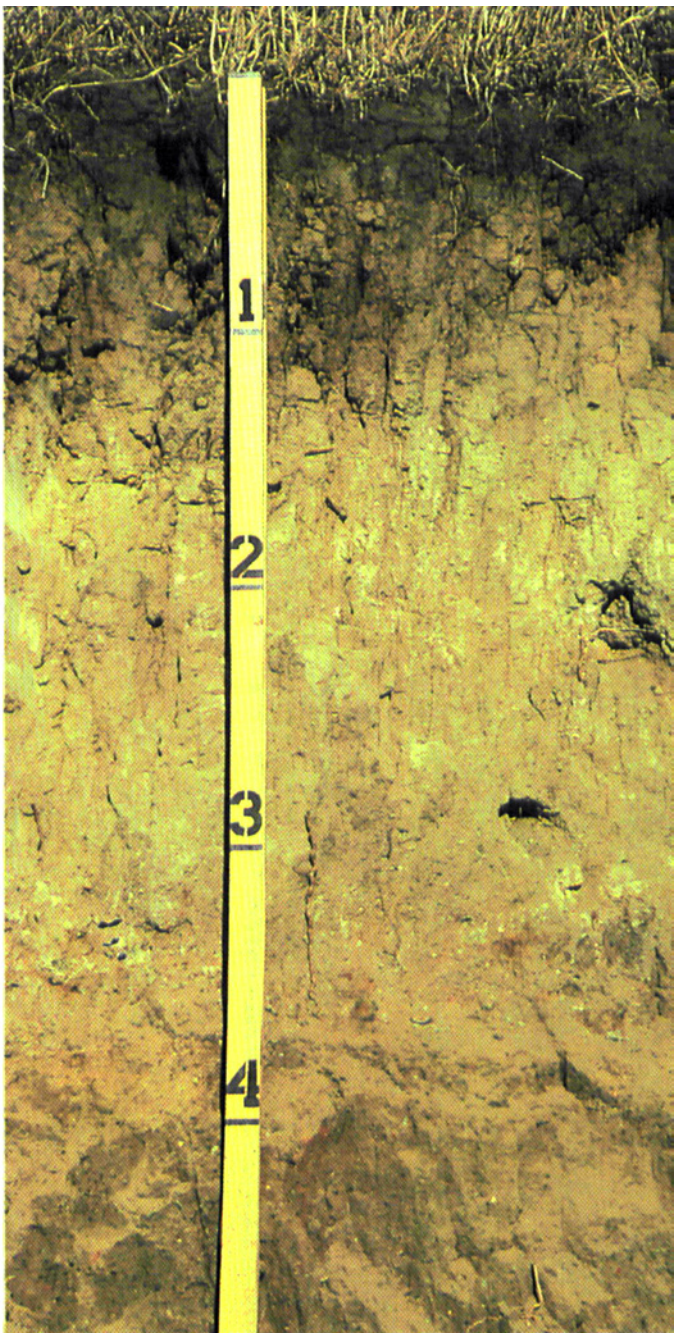

Figure 14.—Profile of Kranzburg silt loam. Silty material is at a depth of about 2 to 3 feet. It is underlain by loamy glacial till. Depth is marked in feet.

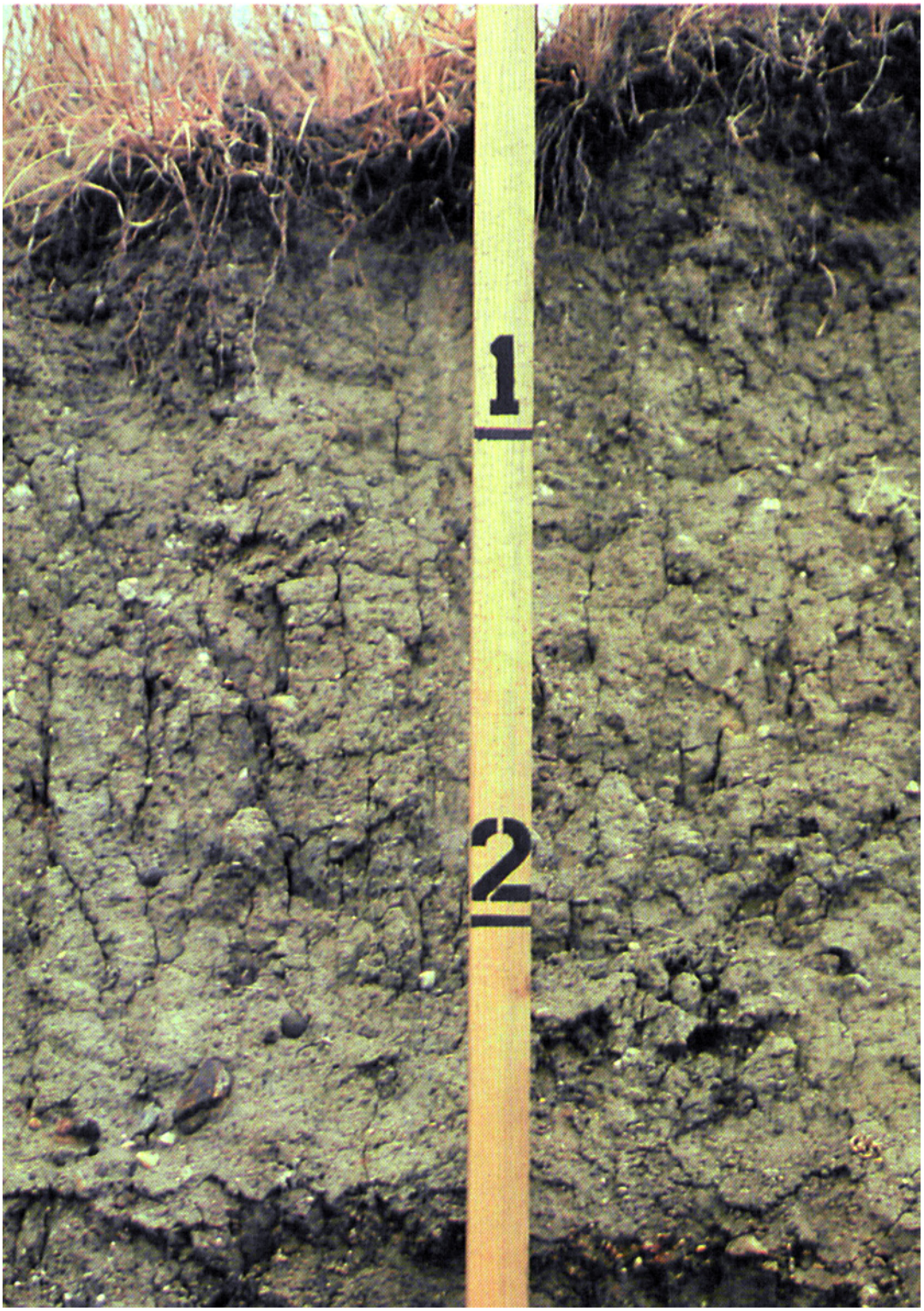

Figure 15.—Profile of Langhei clay loam, which has a very thin surface layer and has lime at the surface. Depth is marked in feet.

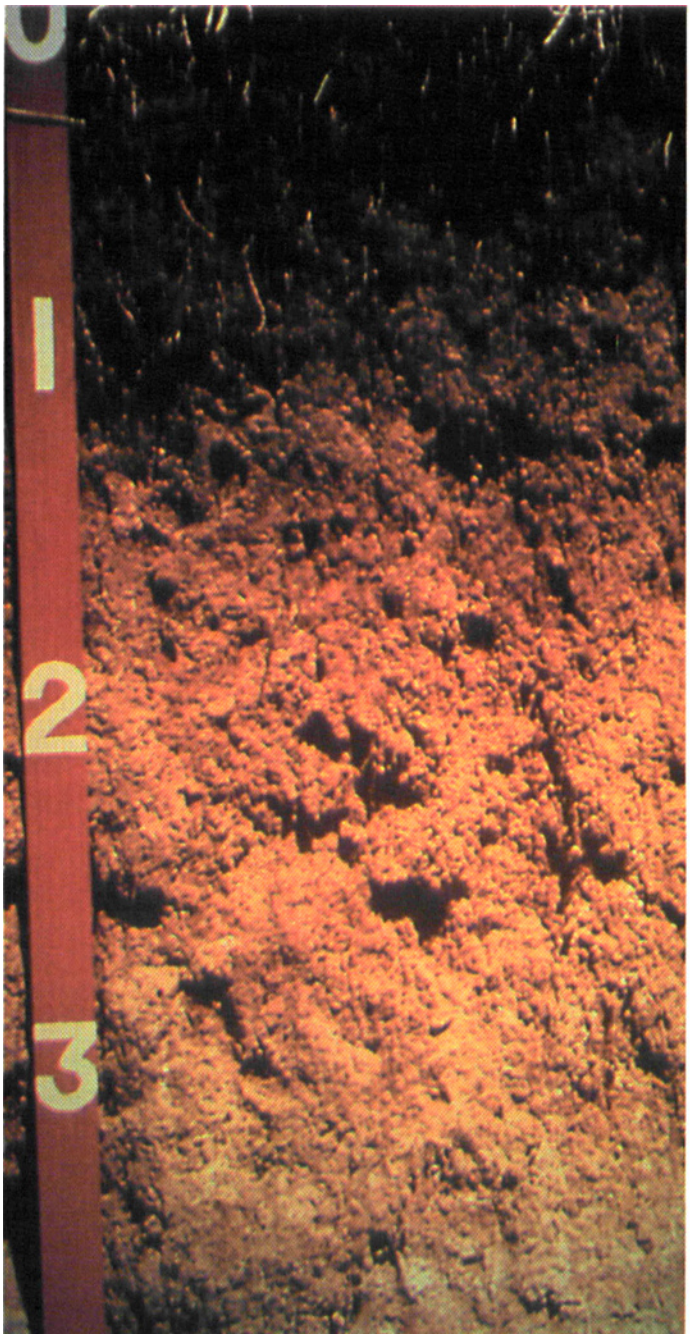

Figure 16.—Profile of Poinsett silty clay loam. This well drained soil formed in silty glacial till. It is dark to a depth of about 15 inches and has accumulations of calcium carbonate at a depth of about 26 inches. Depth is marked in feet.

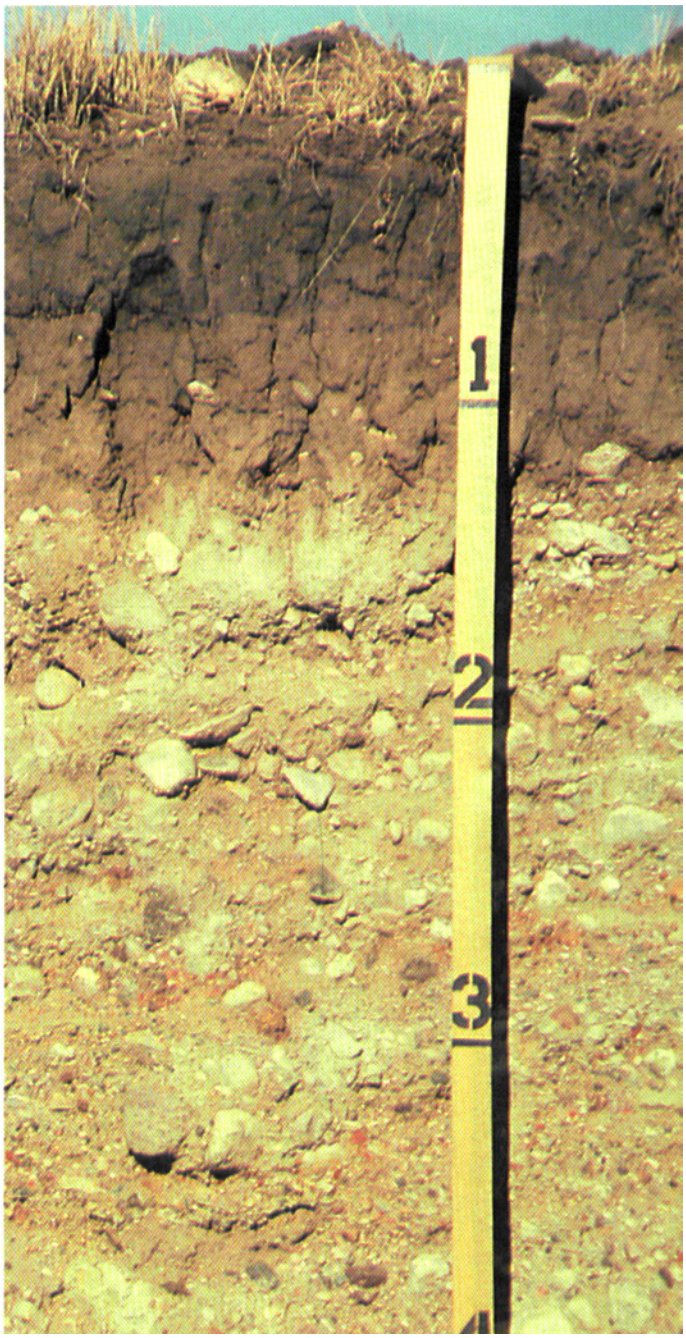

Figure 17.—Profile of Renshaw loam, which has gravelly material at a depth of 14 to 20 inches. Depth is marked in feet.

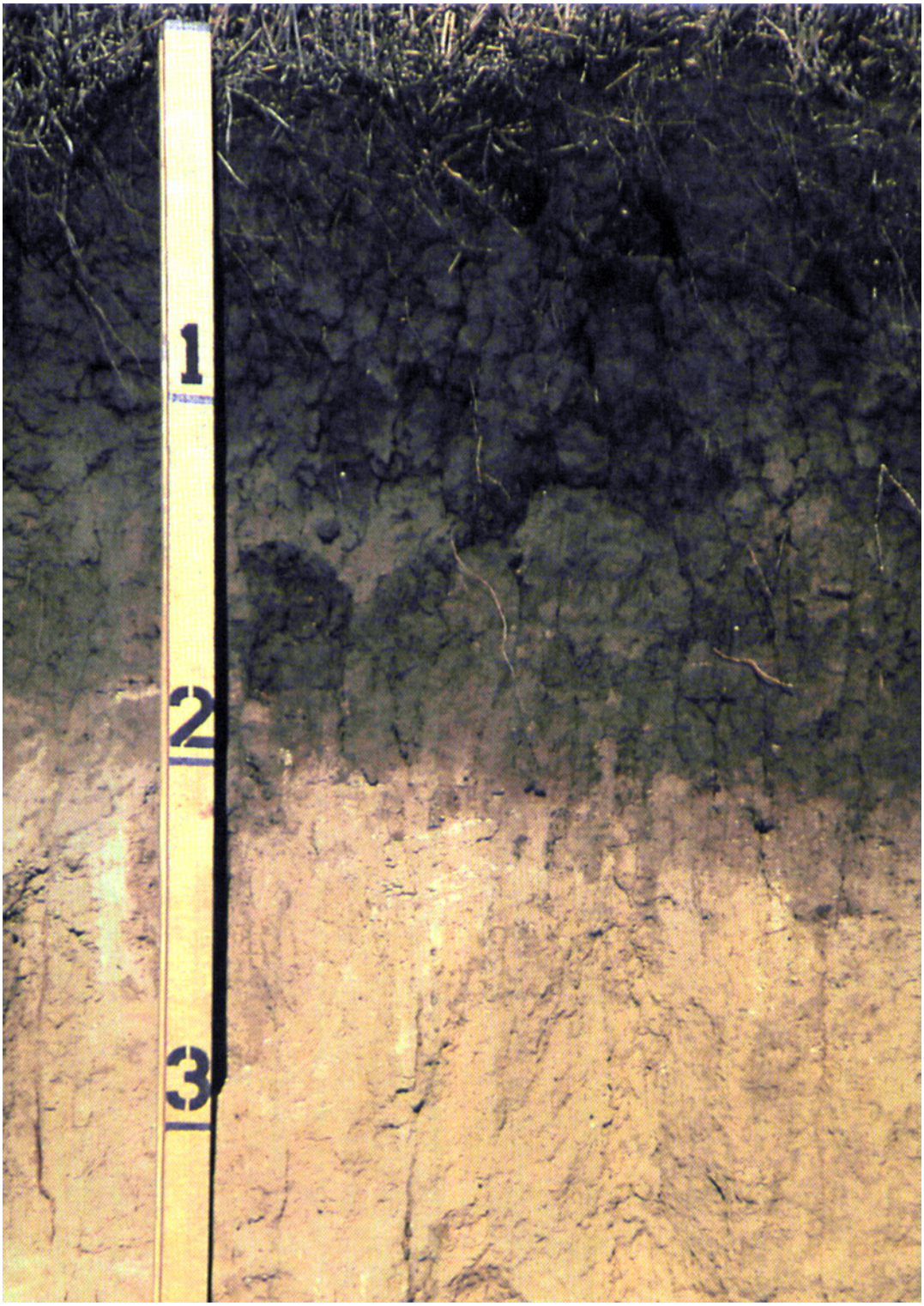

Figure 18.—Profile of Waubay silty clay loam, which is dark to a depth of about 17 to 24 inches. Depth is marked in feet.

Depth to carbonates: 0 to 40 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over loamy material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly sandy loam; loam, fine sandy loam, loamy fine sand, fine sand, or loamy sand in some pedons

Bw horizon:
Hue—10YR
Value—4 to 6 (2 to 5 moist)
Chroma—2 to 4
Texture—fine sand, loamy fine sand, or loamy sand

C horizon:
Hue—10YR or 2.5Y
Value—4 to 7 (3 to 6 moist)
Chroma—2 to 4
Texture—fine sand, loamy fine sand, loamy sand, or sand

Marysland Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the loamy sediments and rapid in the underlying gravelly material
Landform: Flood plains
Parent material: Loamy alluvium over glacial outwash
Slope: 0 to 1 percent

Typical Pedon

Marysland loam, in an area of Marysland-Divide loams, 2,100 feet south and 1,230 feet east of the northwest corner of sec. 32, T. 115 N., R. 57 W.

A—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; many very fine roots; many very fine vesicular and tubular pores; strong effervescence (about 17 percent calcium carbonate equivalent); slightly alkaline; diffuse wavy boundary.

Ak—7 to 11 inches; gray (10YR 6/1) loam, very dark gray (10YR 3/1) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine vesicular and few tubular pores; violent effervescence (about 34 percent calcium carbonate equivalent); slightly alkaline; clear smooth boundary.

Bkg—11 to 28 inches; gray (N 5/0) loam, very dark gray (10YR 3/1) moist; few fine faint very dark gray (5Y 3/1) mottles; weak medium prismatic structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine vesicular and few tubular pores; violent effervescence (about 31 percent calcium carbonate equivalent); moderately alkaline; clear smooth boundary.

2Cg1—28 to 32 inches; light gray (5Y 7/1) very gravelly sand, gray (5Y 6/1) moist; common medium prominent light yellowish brown (2.5Y 6/4) mottles; single grain; loose; very few dark gray (10YR 4/1) accumulations of iron and manganese oxide; about 40 percent gravel; slight effervescence (about 18 percent calcium carbonate equivalent); slightly alkaline; clear smooth boundary.

2Cg2—32 to 42 inches; light gray (5Y 7/1) gravelly sand, gray (5Y 5/1) moist; few fine prominent light yellowish brown (10YR 6/4) mottles; single grain; loose; very few dark gray (10YR 4/1) accumulations of iron and manganese oxide; about 17 percent gravel; slight effervescence (about 9 percent calcium carbonate equivalent); slightly alkaline; gradual smooth boundary.

2Cg3—42 to 60 inches; grayish brown (2.5Y 5/2) very gravelly sand, very dark grayish brown (2.5Y 3/2) moist; few fine distinct gray (10YR 5/1) mottles; single grain; loose; very few very dark gray (N 3/0) accumulations of iron and manganese oxide; very few yellowish brown (10YR 5/6) stains on pebbles; about 40 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 30 inches
Depth to carbonates: 0 to 7 inches
Depth to contrasting or impervious layer: 20 to 40 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly loam; silt loam, sandy clay loam, or clay loam in some pedons

Bkg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 to 8 (3 to 6 moist)
Chroma—0 to 2
Texture—dominantly loam, clay loam, or sandy clay loam; fine sandy loam or sandy loam in some pedons

2Cg horizon:
Hue—2.5Y or 5Y

Value—4 to 7 (3 to 6 moist)
Chroma—1 or 2
Texture—dominantly fine sand, sand, coarse sand, gravelly sand, or very gravelly sand; stratified with loamy sand, loamy coarse sand, gravelly coarse sand, or very gravelly coarse sand in some pedons

Mauvais Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Landform: Wave-cut platforms
Parent material: Loamy glacial till
Slope: 0 to 2 percent

Typical Pedon

Mauvais clay loam, 0 to 2 percent slopes, 150 feet south and 1,150 feet west of the northeast corner of sec. 6, T. 114 N., R. 56 W.

A—0 to 6 inches; gray (10YR 5/1) clay loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; about 2 percent pebbles; strong effervescence; slightly alkaline; clear smooth boundary.

C1—6 to 12 inches; light gray (2.5Y 7/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common medium distinct gray (10YR 6/1) and common fine prominent yellowish brown (10YR 5/8) mottles; massive; slightly hard, friable, sticky and plastic; about 2 percent pebbles; strong effervescence; moderately alkaline; clear smooth boundary.

C2—12 to 30 inches; light gray (2.5Y 7/2) clay loam, olive gray (5Y 5/2) moist; common medium distinct gray (5Y 6/1) and few fine prominent brownish yellow (10YR 6/6) mottles; massive; slightly hard, friable, sticky and plastic; about 2 percent pebbles; strong effervescence; slightly alkaline; clear smooth boundary.

C3—30 to 36 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; many fine faint light brownish gray (2.5Y 6/2), few prominent yellowish red (5YR 5/8), and common fine and medium prominent yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, sticky and plastic; very few very dark gray (10YR 3/1) accumulations of iron and manganese oxide; about 5 percent pebbles; strong effervescence; slightly alkaline; clear smooth boundary.

Cy—36 to 50 inches; gray (5Y 6/1) clay loam, dark gray (5Y 4/1) moist; common fine distinct light gray (2.5Y 7/2) and few prominent yellowish brown (10YR 5/6) mottles; massive; hard, friable, sticky and plastic; common fine and medium nests of gypsum; about 5 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C'—50 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; many medium faint light brownish gray (2.5Y 6/2) and few fine prominent brownish yellow (10YR 6/6) mottles; massive; hard, friable, sticky and plastic; about 8 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 6 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 10 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 or 2
Texture—dominantly loam; clay loam, silty clay loam, silt loam, or sandy loam in some pedons

C horizon:
Hue—2.5Y, 5Y, or neutral
Value—5 to 7 (4 to 6 moist)
Chroma—0 to 4
Texture—dominantly loam; clay loam, silt loam, or silty clay loam in some pedons

Minnewasta Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Rapid in the sandy sediments and slow in the underlying glacial till
Landform: Beach terraces
Parent material: Sandy lacustrine sediments over loamy glacial till
Slope: 0 to 6 percent

Typical Pedon

Minnewasta sandy loam, 2 to 6 percent slopes, 750 feet north and 2,200 feet west of the southeast corner of sec. 18, T. 118 N., R. 57 W.

A—0 to 6 inches; very dark gray (10YR 3/1) sandy loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; many very fine roots and few fine roots; about 5 percent pebbles; very slight effervescence; slightly alkaline; clear wavy boundary.

C1—6 to 12 inches; light gray (2.5Y 7/2) sand, dark grayish brown (2.5Y 4/2) moist; common medium

distinct light gray (10YR 7/1) mottles; loose; single grain; common very fine roots and few fine roots; very few dark yellowish brown (10YR 4/6) iron stains on sand and gravel; about 10 percent pebbles; strong effervescence; slightly alkaline; clear smooth boundary.

2C2—12 to 20 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common medium distinct gray (5Y 6/1) and few fine distinct olive yellow (2.5Y 6/6) mottles; weak medium subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; few fine rounded soft masses of carbonate; about 1 percent pebbles; violent effervescence; moderately alkaline; clear smooth boundary.

2Cg1—20 to 38 inches; light gray (5Y 7/1) clay loam, gray (5Y 5/1) moist; common fine prominent brownish yellow (10YR 6/6) mottles; massive; very hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; very few very dark gray (10YR 3/1) accumulations of iron and manganese oxide; about 1 percent pebbles; violent effervescence; moderately alkaline; gradual smooth boundary.

2Cg2—38 to 60 inches; light gray (5Y 7/1) clay loam, gray (5Y 5/1) moist; common medium faint light gray (10YR 7/1) and few fine prominent yellowish red (5YR 5/8) mottles; massive; extremely hard, friable, sticky and plastic; few very fine roots; few very fine vesicular and tubular pores; very few very dark gray (10YR 3/1) accumulations of iron and manganese oxide; about 3 percent pebbles; violent effervescence; moderately alkaline.

Range in Characteristics

Depth to carbonates: 0 to 6 inches

Depth to contrasting or impervious layer: 10 to 20 inches over glacial till

Depth to gypsum and other salts: 16 to more than 60 inches

A horizon:
- Hue—10YR or 2.5Y
- Value—3 or 4 (2 or 3 moist)
- Chroma—1 or 2
- Texture—dominantly sandy loam; loam, fine sandy loam, loamy sand, or gravelly sand in some pedons

C horizon:
- Hue—2.5Y or 5Y
- Value—5 to 7 (4 or 5 moist)
- Chroma—2 to 4
- Texture—dominantly sand or coarse sand; loamy fine sand, loamy sand, or gravelly sand in some pedons

2C horizon:
- Hue—2.5Y or 5Y
- Value—5 to 7 (4 to 6 moist)
- Chroma—1 to 4
- Texture—sandy clay loam or clay loam

Minnewaukan Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Rapid
Landform: Beach terraces
Parent material: Sandy lacustrine sediments
Slope: 0 to 3 percent

Typical Pedon

Minnewaukan loamy sand, 340 feet south and 350 feet east of the northwest corner of sec. 24, T. 118 N., R. 58 W.

A—0 to 6 inches; dark gray (10YR 4/1) loamy sand, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; many very fine roots throughout; very slightly effervescent; slightly alkaline (pH 7.6); gradual wavy boundary.

C—6 to 20 inches; light brownish gray (2.5Y 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; few medium faint gray (10YR 5/1) and fine prominent brownish yellow (10YR 6/6) mottles; single grain; loose, very friable; common very fine roots throughout; strong effervescence; slightly alkaline (pH 7.6); clear smooth boundary.

Ab—20 to 39 inches; gray (5Y 5/1) loamy fine sand, dark gray (5Y 4/1) moist; common fine faint gray (10YR 5/1) mottles; single grain; loose; few very fine roots throughout; strong effervescence; slightly alkaline (pH 7.6); clear smooth boundary.

C'1—39 to 49 inches; light gray and gray (2.5Y 6/0) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; few fine faint light gray and gray (5Y 6/1) and prominent yellowish brown (10YR 5/6) mottles; single grain; soft, very friable; few very fine roots throughout; strong effervescence; slightly alkaline (pH 7.6); clear smooth boundary.

C'2—49 to 55 inches; light gray and gray (5Y 6/1) loamy sand, dark grayish brown (2.5Y 4/2) moist; common fine faint light gray and gray (10YR 6/1) mottles; single grain; loose; few very fine roots throughout; strong effervescence; slightly alkaline (pH 7.8); clear smooth boundary.

C'3—55 to 60 inches; light gray and gray (5Y 6/1) silty clay loam, gray (2.5Y 5/0) moist; common fine faint light gray and gray (10YR 6/1) and distinct dark gray (10YR 4/1) mottles; massive; slightly hard, friable, sticky and plastic; few very fine roots

throughout; many very fine vesicular and tubular pores; common fine strata of sandy clay loam and sandy loam; violent effervescence; slightly alkaline (pH 7.7).

Range in Characteristics

Depth to carbonates: 0 to 10 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over loamy material
Depth to gypsum and other salts: 30 to more than 60 inches
Other features: A 2C horizon in some pedons

A horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 6 (2 to 4 moist)
Chroma—1 or 2
Texture—dominantly loamy sand; loamy fine sand, loamy coarse sand, fine sandy loam, sandy loam, or sand in some pedons

C horizon:
Hue—10YR, 2.5Y, 5Y, or 5GY
Value—4 to 7 (3 to 5 moist)
Chroma—1 to 4
Texture—loamy sand, fine sand, loamy fine sand, or sand; stratified in some pedons; silty clay loam below a depth of 40 inches

Moritz Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Flood plains
Parent material: Loamy alluvium
Slope: 0 to 2 percent

Typical Pedon

Moritz loam, in an area of Moritz-Lowe loams, 2,600 feet north and 200 feet west of the southeast corner of sec. 28, T. 114 N., R. 59 W.

A1—0 to 5 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium granular structure; slightly hard, very friable; common very fine roots; common very fine vesicular pores; neutral; clear smooth boundary.

A2—5 to 9 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; moderate medium granular structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine vesicular pores; many medium rounded wormcasts; slight effervescence (about 6 percent calcium carbonate equivalent); neutral; clear smooth boundary.

Bk1—9 to 22 inches; light gray (10YR 7/1) silt loam, grayish brown (2.5Y 5/2) moist; moderate medium prismatic structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine vesicular, many tubular, and few fine tubular pores; many coarse rounded soft masses of carbonate; violent effervescence (about 30 percent calcium carbonate equivalent); moderately alkaline; clear smooth boundary.

Bk2—22 to 38 inches; light brownish gray (2.5Y 6/2) loam, olive brown (2.5Y 4/3) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine and fine vesicular and tubular pores; few medium rounded soft masses of carbonate; violent effervescence (about 20 percent calcium carbonate equivalent); moderately alkaline; gradual smooth boundary.

Bk3—38 to 54 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine and fine vesicular and tubular pores; few medium rounded soft masses of carbonate; strong effervescence (about 11 percent calcium carbonate equivalent); slightly alkaline; gradual smooth boundary.

C—54 to 60 inches; light brownish gray (2.5Y 6/2) loamy sand, dark grayish brown (2.5Y 4/2) moist; common medium distinct gray (10YR 6/1) mottles; single grain; loose; very few prominent very dark gray (10YR 3/1) accumulations of iron and manganese oxide; strong effervescence (about 9 percent calcium carbonate equivalent); slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 24 inches
Depth to carbonates: 0 to 6 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly loam; clay loam, silty clay loam, or silt loam in some pedons

Bk horizon:
Hue—10YR, 2.5Y, or 5Y

Value—4 to 7 (3 to 6 moist)
Chroma—1 to 3
Texture—dominantly loam, clay loam, or silt loam; silty clay loam or sandy loam in some pedons

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 or 5 moist)
Chroma—2 to 4
Texture—dominantly loam, sandy loam, or loamy sand, stratified in some pedons; stratified silt loam, clay loam, or silty clay loam in some pedons

Oldham Series

Depth to bedrock: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Oldham silty clay loam, 2,400 feet south and 200 feet west of the northeast corner of sec. 4, T. 119 N., R. 57 W.

Ap—0 to 9 inches; dark gray (5Y 4/1) silty clay loam, black (5Y 2.5/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine tubular pores; few snail shells; slight effervescence; slightly alkaline; clear wavy boundary.

Bg—9 to 20 inches; very dark gray (N 3/0) silty clay loam, black (N 2/0) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine tubular pores; very few snail shells; slight effervescence; slightly alkaline; clear wavy boundary.

Bkg1—20 to 34 inches; dark gray (N 4/0) silty clay loam, black (N 2/0) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; few snail shells; many fine soft masses of carbonate; strong effervescence; slightly alkaline; clear wavy boundary.

Bkg2—34 to 42 inches; gray (5Y 5/1) silty clay loam, very dark gray (5Y 3/1) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; very fine tubular pores; very few snail shells; common medium soft masses of carbonate; strong effervescence; slightly alkaline; clear wavy boundary.

B'g—42 to 49 inches; gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) moist; weak medium subangular blocky structure; very hard, friable, sticky and plastic; many very fine and few fine tubular pores; very few snail shells; few fine soft masses of carbonate; strong effervescence; slightly alkaline; gradual wavy boundary.

Cg—49 to 60 inches; gray (5Y 5/1) silty clay, dark olive gray (5Y 3/2) moist; massive; very hard, firm, sticky and plastic; very few snail shells; few fine soft masses of carbonate; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 60 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over glacial till
Depth to gypsum and other salts: 20 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silty clay loam; silty clay in some pedons

Bg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 or 1
Texture—silty clay loam or silty clay

Bk or Bkg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 7 (2 to 5 moist)
Chroma—0 to 2
Texture—silt loam, silty clay loam, or silty clay

Cg horizon:
Hue—2.5Y or 5Y
Value—4 to 7 (3 to 5 moist)
Chroma—1 or 2
Texture—silty clay loam, silt loam, clay loam, or silty clay

Parnell Series

Depth to bedrock: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Parnell silty clay loam, 200 feet north and 1,450 feet west of the southeast corner of sec. 16, T. 116 N., R. 56 W.

A—0 to 16 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; slightly acid; clear smooth boundary.

Btg1—16 to 23 inches; dark gray (5Y 4/1) silty clay loam, black (5Y 2.5/1) moist; common fine faint olive gray (5Y 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common very fine roots; few fine tubular pores; few shiny films on faces of peds; neutral; gradual wavy boundary.

Btg2—23 to 44 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; common medium faint olive gray (5Y 5/2) mottles; moderate medium subangular blocky structure; extremely hard, firm, sticky and plastic; common very fine roots; few fine and very fine tubular pores; few shiny films on faces of peds; neutral; gradual wavy boundary.

Cg—44 to 60 inches; gray (5Y 6/1) silty clay, grayish brown (2.5Y 5/2) moist; common fine distinct dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) mottles; massive; extremely hard, firm, sticky and plastic; few very fine roots; few fine tubular pores; few fine rounded soft masses of carbonate; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to more than 60 inches

Depth to carbonates: 35 to more than 60 inches

Depth to contrasting or impervious layer: Greater than 60 inches

Depth to gypsum and other salts: Greater than 60 inches

A horizon:
- Hue—10YR, 2.5Y, 5Y, or neutral
- Value—3 or 4 (2 or 3 moist)
- Chroma—0 or 1
- Texture—dominantly silty clay loam; silt loam, loam, or silty clay in some pedons

Btg horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—3 to 5 (2 to 4 moist)
- Chroma—1 or 2
- Texture—dominantly silty clay or silty clay loam; clay loam or clay in some pedons

Cg horizon:
- Hue—10YR, 2.5Y, or 5Y
- Value—4 to 7 (3 to 6 moist)
- Chroma—1 or 2
- Texture—dominantly silty clay, clay loam, or silty clay loam; loam or clay in some pedons

Peever Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Till plains
Parent material: Clayey glacial till
Slope: 0 to 6 percent

Typical Pedon

Peever clay loam, in an area of Peever-Cresbard-Tonka complex, 2,200 feet west and 550 feet south of the northeast corner of sec. 18, T. 115 N., R. 59 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; few very fine roots; about 2 percent pebbles; neutral; abrupt smooth boundary.

Bt—8 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; common very fine roots; shiny films on faces of peds; about 2 percent pebbles; neutral; clear smooth boundary.

Btk—15 to 21 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; common very fine roots; shiny films on faces of peds; few fine rounded soft masses of carbonate; about 3 percent pebbles; strong effervescence; neutral; gradual wavy boundary.

Bk1—21 to 27 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common fine and medium soft masses of carbonate; about 2 percent pebbles; slightly alkaline; gradual wavy boundary.

Bk2—27 to 33 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; hard, firm, sticky and plastic; few very fine roots; very few strong brown (7.5YR 5/8) accumulations of iron and manganese oxide; few fine and medium soft masses of carbonate; about 2 percent pebbles; violent

effervescence; slightly alkaline; gradual wavy boundary.

C1—33 to 48 inches; olive gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; massive; very hard, firm, sticky and plastic; very few strong brown (7.5YR 5/6) accumulations of iron and manganese oxide; about 4 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—48 to 60 inches; olive gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; massive; very hard, firm, sticky and plastic; very few dark reddish brown (5YR 3/2) accumulations of iron and manganese oxide; about 4 percent pebbles; common shale fragments; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Depth to carbonates: 13 to 26 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 55 to more than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly clay loam; loam, silty clay loam, silty clay, or clay in some pedons

Bt horizon:
Hue—10YR or 2.5Y
Value—4 to 6 (2 to 4 moist)
Chroma—1 to 3
Texture—clay, silty clay, or clay loam

Bk horizon:
Hue—2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay or clay loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay or clay loam

Playmoor Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Flood plains
Parent material: Silty alluvium
Slope: 0 to 1 percent

Typical Pedon

Playmoor silty clay loam, 2,180 feet north and 1,400 feet east of the southwest corner of sec. 30, T. 119 N., R. 57 W.

Az—0 to 6 inches; very dark gray (5Y 3/1) silty clay loam, black (5Y 2.5/1) moist; many fine prominent yellowish brown (10YR 5/6) mottles; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine salt masses; strong effervescence; moderately alkaline; abrupt smooth boundary.

Bzg1—6 to 9 inches; dark gray (5Y 4/1) silty clay loam, black (5Y 2.5/1) moist; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; few fine and very fine tubular pores; many fine salt masses; weak effervescence; moderately alkaline; clear wavy boundary.

Bzg2—9 to 27 inches; dark gray (5Y 4/1) silty clay loam, very dark gray (5Y 3/1) moist; common fine prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine and very fine tubular pores; many fine salt masses; very few fine soft masses of carbonates; weak effervescence; slightly alkaline; gradual wavy boundary.

Bzg3—27 to 37 inches; very dark gray (5Y 3/1) silty clay loam, black (5Y 2.5/1) moist; common fine prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine tubular pores; common fine salt masses; weak effervescence; slightly alkaline; clear wavy boundary.

Bg—37 to 50 inches; dark gray (5Y 4/1) silty clay loam, black (5Y 2.5/1) moist; many fine prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; few fine and very fine tubular pores; few fine salt masses; weak effervescence; slightly alkaline; clear wavy boundary.

Cg—50 to 60 inches; gray (5Y 5/1) silty clay loam, very dark gray (5Y 3/1) moist; common fine prominent yellowish brown (10YR 5/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; common fine and very fine tubular pores; few fine soft masses of carbonates; weak effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to more than 60 inches
Carbonates: At the surface
Depth to contrasting or impervious layer: 40 to more than 60 inches over glacial till or gravelly material
Depth to gypsum and other salts: 0 to 7 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silty clay loam; silt loam in some pedons

Bzg or Bg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 7 (2 to 4 moist)
Chroma—0 or 1
Texture—silty clay loam or silt loam

Cg horizon:
Hue—2.5Y, 5Y, or neutral
Value—5 to 7 (3 to 6 moist)
Chroma—0 to 2
Texture—silty clay loam

Poinsett Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains and moraines
Parent material: Silty glacial till
Slope: 0 to 9 percent

Typical Pedon

Poinsett silty clay loam (fig. 16), in an area of Poinsett-Waubay silty clay loams, 1 to 6 percent slopes, 110 feet south and 1,640 feet west of the northeast corner of sec. 35, T. 115 N., R. 56 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky; many very fine roots; slightly acid; clear smooth boundary.

Bw1—8 to 15 inches; brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; few very fine tubular pores; neutral; clear wavy boundary.

Bw2—15 to 26 inches; light olive brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky; common very fine roots; common very fine and few fine tubular pores; neutral; clear wavy boundary.

Bk1—26 to 36 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; common very fine roots; common very fine and few fine tubular pores; common fine soft masses of carbonate; violent effervescence; slightly alkaline; gradual wavy boundary.

Bk2—36 to 48 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; few fine prominent light gray (5Y 7/1) and yellow (10YR 7/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; few very fine roots; many very fine and few fine tubular pores; strong effervescence; moderately alkaline; gradual wavy boundary.

C—48 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; few fine prominent light gray (5Y 7/1), brownish yellow (10YR 6/6), and yellow (10YR 7/6) mottles; massive; hard, friable; many fine and few fine tubular pores; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Depth to carbonates: 14 to 30 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over loamy glacial till
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly silty clay loam; silt loam or clay loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—4 to 6 (2 to 4 moist)
Chroma—1 to 4
Texture—dominantly silt loam or silty clay loam; clay loam in some pedons

Bk horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—silt loam or silty clay loam

C horizon:
Hue—2.5Y or 5Y

Value—6 or 7 (5 or 6 moist)
Chroma—1 to 4
Texture—dominantly silt loam or silty clay loam; thin strata of sandy loam to silty clay loam in some pedons

Prosper Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 6 percent

Typical Pedon

Prosper loam, in an area of Houdek-Prosper loams, 1 to 6 percent slopes, 320 feet east and 1,100 feet south of the northwest corner of sec. 8, T. 113 N., R. 58 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable; many very fine roots; few very fine and fine vesicular and tubular pores; about 1 percent pebbles; slightly acid; abrupt smooth boundary.

A—9 to 13 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine and medium granular; slightly hard, friable; common very fine roots; many very fine and fine tubular pores; about 1 percent pebbles; neutral; gradual wavy boundary.

Bt1—13 to 27 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; common very fine roots; common very fine and fine vesicular and tubular pores; shiny films on faces of peds; about 1 percent pebbles; neutral; gradual smooth boundary.

Bt2—27 to 32 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine and fine vesicular and tubular pores; shiny films on faces of peds and in pores; about 2 percent pebbles; neutral; gradual smooth boundary.

Bk1—32 to 41 inches; light yellowish brown (2.5Y 6/3) loam, olive brown (2.5Y 4/3) moist; weak medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine and fine vesicular and tubular pores; many fine and medium irregular soft masses of carbonate; about 5 percent pebbles; slightly alkaline; gradual smooth boundary.

Bk2—41 to 48 inches; light yellowish brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/3) moist; common fine prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C1—48 to 55 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/3) moist; few fine prominent strong brown (7.5YR 5/8) mottles; massive; hard, firm, slightly sticky and slightly plastic; few very fine vesicular and tubular pores; very few prominent dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—55 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/3) moist; few fine prominent strong brown (7.5YR 5/8) mottles; massive; hard, firm, slightly sticky and slightly plastic; few very fine vesicular and tubular pores; very few prominent dark brown (7.5YR 3/2) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 5 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 30 inches
Depth to carbonates: 20 to 36 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly loam; silt loam in some pedons

Bt horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 to 3
Texture—dominantly clay loam; silty clay loam in some pedons

Bk horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—loam or clay loam

Ranslo Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Slow
Landform: Flood plains
Parent material: Clayey alluvium
Slope: 0 to 2 percent

Typical Pedon

Ranslo silty clay loam, 2,100 feet south and 1,200 feet east of the northwest corner of sec. 31, T. 115 N., R. 59 W.

A—0 to 6 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak medium platy parting to weak fine granular; many very fine roots; many very fine vesicular and tubular pores; neutral; clear wavy boundary.

Btn—6 to 12 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium columnar structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common very fine roots between peds; common very fine vesicular and tubular pores; gray (10YR 6/1) sand and silt coatings on tops of columns; shiny films on faces of peds; slightly alkaline; gradual wavy boundary.

Btnz—12 to 24 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine vesicular and tubular pores; shiny films on faces of peds; few fine irregular salt masses; slight effervescence; slightly alkaline; gradual wavy boundary.

Bkz—24 to 30 inches; gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common very fine roots; few very fine vesicular and tubular pores; common fine irregular soft masses of carbonate; common fine rounded salt masses; about 6 percent pebbles; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—30 to 36 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine prominent yellowish brown (10YR 5/6) mottles; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine vesicular and tubular pores; common fine irregular soft masses of carbonate; about 10 percent pebbles; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; gray (5YR 6/1) sandy clay loam, gray (5YR 5/1) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very dark gray (5YR 3/1) accumulations of iron and manganese oxide; few fine irregular soft masses of carbonate; about 14 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 40 inches
Depth to carbonates: 14 to 30 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 16 to 40 inches

A horizon:
Hue—10YR
Value—4 or 5 (2 or 3 moist)
Chroma—1
Texture—dominantly silty clay loam; silt loam or loam in some pedons

Btn horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 or 3 moist)
Chroma—1
Texture—silty clay loam, silty clay, or clay loam

Bkz horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 7 (3 to 6 moist)
Chroma—1 to 3
Texture—dominantly sandy clay loam, clay loam, or silty clay loam; silty clay or clay in some pedons

C horizon:
Hue—2.5Y or 5Y
Value—4 to 7 (3 to 6 moist)
Chroma—1 to 4
Texture—dominantly clay loam, sandy clay loam, or silty clay loam; silty clay or clay in some pedons

Rauville Series

Depth to bedrock: Very deep
Drainage class: Very poorly drained

Permeability: Moderately slow
Landform: Flood plains
Parent material: Silty alluvium
Slope: 0 to 1 percent

Typical Pedon

Rauville silty clay loam, 1,650 feet north and 900 feet east of the southwest corner of sec. 2, T. 114 N., R. 56 W.

A1—0 to 10 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; few fine prominent brownish yellow (10YR 6/6) mottles; weak fine granular structure; slightly hard, friable; many very fine roots; common very fine vesicular pores; slight effervescence; slightly alkaline; gradual smooth boundary.

A2—10 to 22 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak medium platy structure; slightly hard, friable; common very fine roots; common very fine vesicular and few tubular pores; common fine soft masses of carbonate; slight effervescence; slightly alkaline; gradual smooth boundary.

A3—22 to 31 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard; common very fine roots; common very fine vesicular and tubular pores; slight effervescence; slightly alkaline; gradual smooth boundary.

A4—31 to 41 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine vesicular and tubular pores; few fine soft masses of carbonate; strong effervescence; slightly alkaline; gradual smooth boundary.

Bkg—41 to 58 inches; gray (5Y 6/1) silty clay loam, dark gray (5Y 4/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine vesicular and tubular pores; common medium soft masses of carbonate; strong effervescence; slightly alkaline; gradual smooth boundary.

Cg—58 to 60 inches; light gray (5Y 7/1) silty clay loam, gray (5Y 5/1) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very few prominent very dark gray (10YR 3/1) accumulations of iron and manganese oxide; few medium soft masses of carbonate; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to more than 60 inches
Depth to carbonates: At the surface
Depth to contrasting or impervious layer: 40 to more than 60 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches
Other features: Some pedons have a 2C horizon of gravelly material below a depth of 40 inches.

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 to 2
Texture—dominantly silty clay loam; silt loam in some pedons

Cg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—5 to 8 (2 to 6 moist)
Chroma—0 to 2
Texture—dominantly silty clay loam or silt loam; silty clay, clay loam, or loam in some pedons

Renshaw Series

Depth to bedrock: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Landform: Outwash plains and moraines
Parent material: Loamy alluvium over glacial outwash
Slope: 0 to 15 percent

Typical Pedon

Renshaw loam (fig. 17), in an area of Renshaw-Fordville loams, 0 to 2 percent slopes, 2,510 feet south and 1,125 feet east of the northwest corner of sec. 1, T. 117 N., R. 59 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; many very fine roots; about 5 percent pebbles; slightly acid; abrupt smooth boundary.

Bw—8 to 16 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common very fine roots; common fine and very fine tubular pores; about 5 percent pebbles; slightly alkaline; clear smooth boundary.

Bk—16 to 19 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/3) moist; moderate medium subangular blocky structure; very hard,

friable; common roots; few fine and common very fine tubular pores; common fine soft masses of carbonate; few fine concretions of carbonate; about 8 percent pebbles; strong effervescence; slightly alkaline; abrupt wavy boundary.

2C1—19 to 40 inches; light gray (2.5Y 7/2) very gravelly loamy sand, grayish brown (2.5Y 5/2) moist; single grain; loose; few roots; carbonate coatings on the underside of pebbles; about 45 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

2C2—40 to 60 inches; light gray (2.5Y 7/2) very gravelly loamy sand, grayish brown (2.5Y 5/2) moist; strong brown (7.5YR 5/8) stains on sand and gravel; single grain; loose; about 50 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 10 to 16 inches
Depth to carbonates: 14 to 20 inches
Depth to contrasting or impervious layer: 14 to 20 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches
Other features: Some pedons do not have a Bk horizon.

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly loam; gravelly loam or sandy loam in some pedons

Bw horizon:
Hue—10YR
Value—3 to 5 (3 or 4 moist)
Chroma—1 to 4
Texture—dominantly loam; sandy loam, sandy clay loam, or gravelly loam in some pedons

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—gravelly loamy sand, very gravelly loamy sand, gravelly sand, very gravelly sand, gravelly coarse sand, very gravelly coarse sand, or coarse sand

Rusklyn Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Till plains and moraines
Parent material: Silty glacial till
Slope: 2 to 9 percent

Typical Pedon

Rusklyn silty clay loam, in an area of Poinsett-Rusklyn-Waubay silty clay loams, 1 to 6 percent slopes, 530 feet north and 170 feet west of the southeast corner of sec. 19, T. 115 N., R. 56 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; many very fine and fine roots; strong effervescence (about 8 percent calcium carbonate equivalent); slightly alkaline; clear smooth boundary.

Bk1—10 to 18 inches; light gray (2.5Y 7/2) silt loam, light yellowish brown (2.5Y 6/4) moist; few fine distinct strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; slightly hard, very friable; common very fine roots; many very fine vesicular and tubular pores; common fine soft masses of carbonate; violent effervescence (about 30 percent calcium carbonate equivalent); slightly alkaline; clear wavy boundary.

Bk2—18 to 33 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; common medium prominent brownish yellow (10YR 6/6) and few fine strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; common very fine and fine roots; many very fine vesicular and tubular pores; common fine soft masses of carbonate; violent effervescence (about 25 percent calcium carbonate equivalent); moderately alkaline; gradual wavy boundary.

C1—33 to 48 inches; light gray (10YR 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; common medium prominent strong brown (7.5YR 5/6) and few fine distinct light yellowish brown (10YR 6/4) mottles; massive; hard, friable; few very fine and fine roots; few fine soft masses of carbonate; strong effervescence (about 10 percent calcium carbonate equivalent); moderately alkaline; gradual wavy boundary.

2C2—48 to 60 inches; light gray (2.5Y 7/2) clay loam, light olive brown (2.5Y 5/4) moist; common medium distinct strong brown (7.5YR 5/6) and few fine prominent gray (10YR 6/1) mottles; massive; very hard, firm, slightly sticky and slightly plastic; about 4 percent pebbles; strong effervescence (about 12 percent calcium carbonate equivalent); moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 10 inches
Depth to carbonates: 0 to 5 inches

Depth to contrasting or impervious layer: 40 to more than 60 inches over loamy glacial till
Depth to gypsum and other salts: Greater than 60 inches
Other features: Some pedons do not have a 2C horizon.

A horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly silty clay loam; silt loam in some pedons

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 7 (3 to 6 moist)
Chroma—2 to 4
Texture—dominantly silty clay loam; silt loam in some pedons

C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—silty clay loam or silt loam

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay loam or loam

Salmo Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Flood plains
Parent material: Silty alluvium
Slope: 0 to 1 percent

Typical Pedon

Salmo silty clay loam, 200 feet south and 1,300 feet west of the northeast corner of sec. 35, T. 113 N., R. 58 W.

Az—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine vesicular pores; common fine and medium irregular salt masses; slight effervescent; slightly alkaline; gradual smooth boundary.

Bzg1—7 to 15 inches; dark gray (5Y 4/1) silty clay loam, black (5Y 2.5/1) moist; weak medium prismatic structure parting to weak fine granular; hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine vesicular pores; common fine and medium irregular salt masses; strong effervescence; moderately alkaline; clear smooth boundary.

Bzg2—15 to 32 inches; dark gray (5Y 4/1) silty clay loam, black (5Y 2.5/1) moist; weak medium prismatic structure parting to weak fine granular; hard, friable, sticky and plastic; common very fine roots; few very fine vesicular and tubular pores; common medium irregular salt masses; strong effervescence; moderately alkaline; clear smooth boundary.

Bg—32 to 40 inches; dark gray (5Y 4/1) silty clay loam, black (5Y 2.5/1) moist; weak medium platy structure parting to weak thin platy; slightly hard, friable, sticky and plastic; few very fine roots; common very fine vesicular and few very fine and fine tubular pores; common fine rounded soft masses of carbonate; strong effervescence; slightly alkaline; gradual smooth boundary.

Cg1—40 to 53 inches; dark gray (5Y 4/1) clay loam, black (5Y 2.5/1) moist; massive; hard, friable, sticky and plastic; few very fine roots; few very fine and fine vesicular and tubular pores; few fine rounded soft masses of carbonate; strong effervescence; slightly alkaline; about 14 percent pebbles; clear smooth boundary.

Cg2—53 to 60 inches; dark gray (5Y 4/1) clay loam, black (5Y 2.5/1) moist; massive; hard, friable, very sticky and very plastic; few very fine roots; common very fine tubular pores; about 5 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 45 inches
Carbonates: At the surface
Depth to contrasting or impervious layer: 40 to more than 60 inches over gravelly material
Gypsum and other salts: At the surface

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silt loam; silty clay loam in some pedons

Bzg or Bg horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 5 (2 to 4 moist)
Chroma—0 to 2
Texture—silt loam or silty clay loam

Cg horizon:
Hue—2.5Y, 5Y, or neutral
Value—3 to 6 (2 to 4 moist)
Chroma—0 to 2

Texture—silt loam, silty clay loam, clay loam, or loam

Sinai Series

Depth to bedrock: Very deep
Drainage class: Well drained
Permeability: Very slow
Landform: Ice-walled lake plains
Parent material: Clayey glaciolacustrine sediments
Slope: 0 to 6 percent

Typical Pedon

Sinai silty clay, 2 to 6 percent slopes, 1,240 feet north and 1,320 feet east of the southwest corner of sec. 23, T. 116 N., R. 57 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, friable, sticky and plastic; few very fine roots; neutral; abrupt smooth boundary.

Bw1—9 to 16 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; weak medium and coarse prismatic structure parting to moderate medium angular blocky; hard, firm, sticky and plastic; common very fine roots; shiny films on faces of peds; neutral; clear smooth boundary.

Bw2—16 to 23 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium and coarse prismatic structure parting to moderate medium angular blocky; hard, friable, sticky and plastic; common very fine roots; shiny films on faces of peds; slightly alkaline; clear wavy boundary.

Bk1—23 to 28 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; weak medium prismatic structure parting to moderate medium angular blocky; hard, friable, sticky and plastic; common very fine roots; very dark gray (10YR 3/1) tongues; shiny films on faces of peds; strong effervescence; slightly alkaline; clear smooth boundary.

Bk2—28 to 32 inches; light gray (10YR 7/1) silty clay, gray (10YR 5/1) moist; weak medium subangular blocky structure; hard, firm, very sticky and plastic; common very fine roots; very dark gray (10YR 3/1) tongues; shiny films on faces of peds; strong effervescence; slightly alkaline; clear smooth boundary.

C1—32 to 42 inches; gray (10YR 6/1) silty clay, grayish brown (10YR 5/2) moist; massive; very hard, firm, very sticky and plastic; few very fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

C2—42 to 55 inches; gray (10YR 6/1) silty clay, gray (10YR 5/1) moist; massive; varved; very hard, firm, very sticky and plastic; thin strata of silt loam; few soft masses of carbonate in seams; strong effervescence; slightly alkaline; clear smooth boundary.

C3—55 to 60 inches; light gray (10YR 7/1) silty clay, grayish brown (10YR 5/2) moist; few fine prominent yellowish brown (10YR 5/6) mottles; massive; varved; very hard, firm, very sticky and plastic; thin strata of silt loam; few nests of gypsum in seams; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 25 inches
Depth to carbonates: 17 to 34 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly silty clay; silty clay loam, clay loam, or clay in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 6 (2 to 4 moist)
Chroma—1 to 3
Texture—dominantly silty clay or clay; silty clay loam in some pedons

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 7 (3 to 6 moist)
Chroma—1 to 6
Texture—silty clay loam or silty clay

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—4 to 7 (3 to 6 moist)
Chroma—1 to 6
Texture—dominantly silty clay loam or silty clay; stratified clay loam or silt loam in some pedons

Sioux Series

Depth to bedrock: Very deep
Drainage class: Excessively drained
Permeability: Very rapid
Landform: Outwash plains and moraines
Parent material: Loamy alluvium over glacial outwash
Slope: 1 to 40 percent

Typical Pedon

Sioux gravelly loam, in an area of Renshaw-Sioux

complex, 2 to 6 percent slopes, 570 feet south and 1,100 feet east of the northwest corner of sec. 26, T. 118 N., R. 59 W.

A—0 to 7 inches; very dark gray (10YR 3/1) gravelly loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; many very fine roots; about 18 percent gravel; slight effervescence; neutral; clear smooth boundary.

AC—7 to 11 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, very friable; common very fine roots; carbonate coatings on the underside of pebbles; about 18 percent gravel; strong effervescence; slightly alkaline; clear wavy boundary.

C1—11 to 26 inches; light brownish gray (10YR 6/2) very gravelly loamy sand, brown (10YR 5/3) moist; single grain; loose; few very fine roots; carbonate coatings on the underside of pebbles; about 60 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

C2—26 to 43 inches; light yellowish brown (10YR 6/4) very gravelly sand, yellowish brown (10YR 5/4) moist; single grain; loose; carbonate coatings on the underside of pebbles; about 50 percent gravel; strong effervescence; slightly alkaline; gradual wavy boundary.

C3—43 to 60 inches; pale brown (10YR 6/3) very gravelly sand, yellowish brown (10YR 5/4) moist; single grain; loose; about 50 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 14 inches
Depth to carbonates: 0 to 8 inches
Depth to contrasting or impervious layer: 6 to 14 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1
Texture—dominantly gravelly loam; sandy loam, gravelly sandy loam, loam, loamy sand, loamy coarse sand, or gravelly loamy sand in some pedons

C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—dominantly gravelly sand, gravelly loamy sand, very gravelly loamy sand, or very gravelly sand; extremely gravelly sand, very gravelly coarse sand, or extremely gravelly coarse sand in some pedons

Southam Series

Depth to bedrock: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Southam silty clay loam, 225 feet north and 633 feet east of the southwest corner of sec. 2, T. 117 N., R. 57 N.

Ag1—0 to 9 inches; gray (5Y 5/1) silty clay loam, very dark gray (5Y 3/1) moist; moderate medium granular structure; slightly hard, friable, sticky and plastic; few very fine and fine roots; few fine vesicular and tubular pores; few fine snail-shell fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Ag2—9 to 19 inches; gray (5Y 5/1) silty clay loam, very dark gray (5Y 3/1) moist; common medium distinct dark gray (N 4/0) mottles; moderate medium granular structure; slightly hard, firm, sticky and plastic; few very fine and fine roots; many vesicular and tubular pores; few fine snail-shell fragments; strong effervescence; moderately alkaline; clear smooth boundary.

Ag3—19 to 31 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; weak medium subangular blocky structure; very hard, very firm, very sticky and very plastic; few fine snail-shell fragments; very slight effervescence; moderately alkaline; gradual smooth boundary.

Cg1—31 to 43 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; common fine distinct gray (5Y 6/1) mottles; massive; very hard, very firm, very sticky and very plastic; few fine snail-shell fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg2—43 to 50 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; common medium faint dark gray (5Y 4/1) mottles; massive; very hard, very firm, very sticky and very plastic; few fine snail-shell fragments; common medium irregular nests of gypsum; strong effervescence; slightly alkaline; clear smooth boundary.

Cg3—50 to 60 inches; gray (5Y 5/1) silty clay, very dark gray (5Y 3/1) moist; massive; very hard, very firm, very sticky and very plastic; few medium rounded

soft masses of carbonate; few fine gypsum crystals; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 60 inches
Depth to carbonates: 0 to 10 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 25 to more than 60 inches

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 to 2
Texture—dominantly silty clay loam; silty clay, clay loam, silt loam, or clay in some pedons

Cg horizon:
Hue—2.5Y, 5Y, 5GY, or neutral
Value—4 to 8 (3 to 7 moist)
Chroma—0 to 2
Texture—dominantly silty clay; silty clay loam, clay loam, or clay in some pedons

Spottswood Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the loamy sediments and very rapid in the underlying gravelly material
Landform: Outwash plains
Parent material: Loamy alluvium over glacial outwash
Slope: 0 to 2 percent

Typical Pedon

Spottswood clay loam, 330 feet south and 650 feet east of the northwest corner of sec. 5, T. 117 N., R. 57 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure parting to weak medium granular; soft, very friable; common very fine and fine roots; common fine vesicular and tubular pores; about 1 percent pebbles; neutral; clear smooth boundary.

Bw1—6 to 16 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure; slightly hard, friable; common fine roots; few fine tubular pores; about 1 percent pebbles; slightly alkaline; clear smooth boundary.

Bw2—16 to 20 inches; dark grayish brown (10YR 4/2) loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium granular; common fine roots; common very fine vesicular and tubular pores; about 1 percent pebbles; slight effervescence; slightly alkaline; clear wavy boundary.

Bk—20 to 29 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; few fine prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; slightly hard, friable; common fine roots; many very fine vesicular and tubular pores; common medium irregular soft masses of carbonate; about 6 percent pebbles; violent effervescence; slightly alkaline; clear smooth boundary.

2C1—29 to 42 inches; grayish brown (2.5Y 5/2) gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; few fine prominent yellowish red (5YR 4/6) mottles; single grain; loose; few fine roots; about 25 percent gravel; strong effervescence; slightly alkaline; clear smooth boundary.

2C2—42 to 47 inches; light brownish gray (2.5Y 6/2) gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; few fine prominent yellowish red (5YR 4/6) mottles; single grain; loose; very few prominent very dark grayish brown (10YR 3/2) patchy stains of iron and manganese oxide on sand and gravel; about 22 percent gravel; slightly alkaline; clear smooth boundary.

2C3—47 to 60 inches; light brownish gray (2.5Y 6/2) gravelly sand, dark grayish brown (2.5Y 4/2) moist; common medium distinct gray (10YR 5/1) and fine prominent light yellowish brown (10YR 6/4) mottles; single grain; loose; about 16 percent gravel; very few prominent very dark grayish brown (10YR 3/2) stains of iron and manganese oxide on sand and gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 34 inches
Depth to carbonates: 16 to more than 60 inches
Depth to contrasting or impervious layer: 20 to 40 inches over gravelly material
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly clay loam; silt loam, fine sandy loam, sandy loam, or loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 or 2
Texture—clay loam or loam

Bk horizon:
Hue—10YR or 2.5Y

Value—5 to 7 (4 or 5 moist)
Chroma—2 to 4
Texture—loam or clay loam

2C horizon:
Hue—10YR or 2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—sand, gravelly sand, gravelly loamy sand, or very gravelly sand

Stickney Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 6 percent

Typical Pedon

Stickney silt loam, in an area of Houdek-Stickney complex, 2 to 6 percent slopes, 1,150 feet east and 600 feet south of the northwest corner of sec. 35, T. 114 N., R. 59 W.

A—0 to 6 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; many very fine and fine roots; many very fine tubular pores; moderately acid; clear smooth boundary.

E—6 to 9 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium platy structure parting to weak fine granular; slightly hard, very friable; many very fine and fine roots; many very fine tubular pores; slightly acid; clear smooth boundary.

B/E—9 to 11 inches; dark gray (10YR 4/1) silty clay loam (B), very dark gray (10YR 3/1) moist; gray (10YR 5/1), clean sand grains (E), dark gray (10YR 4/1) moist; moderate fine and medium angular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular and few fine and medium vesicular pores; neutral; gradual wavy boundary.

Btn1—11 to 20 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky parting to moderate fine angular blocky; very hard, firm, sticky and plastic; common fine and medium roots in cracks and common very fine and fine roots between peds; common very fine and fine tubular and few fine and medium vesicular pores; shiny films on faces of peds; about 2 percent pebbles; slightly acid; clear smooth boundary.

Btn2—20 to 30 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; few fine and medium roots in cracks and few very fine and fine roots between peds; few very fine tubular pores; shiny films on faces of peds; about 2 percent pebbles; neutral; clear smooth boundary.

Bkz—30 to 34 inches; pale yellow (2.5Y 7/3) clay loam, light olive brown (2.5Y 5/3) moist; few fine distinct brownish yellow (10YR 6/8) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; common fine rounded carbonate concretions; few fine salt masses; about 3 percent pebbles; violent effervescence; slightly alkaline; clear smooth boundary.

Bk—34 to 40 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/4) moist; common fine and medium distinct reddish yellow (7.5YR 6/8) mottles; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; common fine vesicular and tubular pores; common fine and medium irregular soft masses of carbonate; about 4 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C—40 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/3) moist; common fine and medium prominent yellowish red (5YR 5/6) and many reddish yellow (7.5YR 6/8) mottles; massive; hard, friable, slightly sticky and slightly plastic; few dark reddish brown (5YR 3/2) accumulations of iron and manganese oxide; few fine and medium irregular soft masses of carbonate; about 10 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 40 inches
Depth to carbonates: 20 to 49 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 20 to more than 60 inches

A horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly silt loam; loam or silty clay loam in some pedons

E horizon:
Hue—10YR
Value—5 or 6 (3 or 4 moist)
Chroma—1 to 3
Texture—silt loam, loam, or silty clay loam

Btn horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 to 3
Texture—clay loam, silty clay loam, silty clay, or clay

Bkz or Bk horizon:
Hue—2.5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 or 3
Texture—clay loam or silty clay loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—clay loam or loam

Svea Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Loamy glacial till
Slope: 0 to 6 percent

Typical Pedon

Svea loam, in an area of Barnes-Svea loams, 1 to 6 percent slopes, 1,250 feet west and 700 feet north of the southeast corner of sec. 4, T. 117 N., R. 58 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable; common very fine and fine roots; few fine vesicular and tubular pores; slightly acid; neutral; abrupt smooth boundary.

A—8 to 15 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable; many very fine and fine roots; common vesicular and tubular pores; slightly acid; clear smooth boundary.

Bw1—15 to 20 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common very fine and fine roots; common vesicular and tubular pores; slightly acid; clear wavy boundary.

Bw2—20 to 26 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; hard, firm; few very fine and fine roots; common vesicular and tubular pores; neutral; clear wavy boundary.

Bw3—26 to 31 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak fine prismatic structure parting to moderate medium subangular blocky; hard, firm; few very fine and fine roots; common vesicular and tubular pores; about 2 percent pebbles; neutral; clear wavy boundary.

Bk1—31 to 41 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; few fine prominent yellowish brown (10YR 5/6) and common medium faint gray (10YR 6/1) mottles; moderate medium subangular blocky structure; slightly hard, friable; few very fine and fine roots; few vesicular and tubular pores; common fine brown (7.5YR 4/2) accumulations of iron and manganese oxide; common fine accumulations of carbonate; about 3 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

Bk2—41 to 48 inches; light brownish gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/3) moist; few fine faint brownish yellow (10YR 6/6) and gray (10YR 6/1) mottles; weak medium subangular blocky structure; hard, friable; few fine brown (7.5YR 4/2) accumulations of iron and manganese oxide; few medium accumulations of carbonate; about 3 percent pebbles; strong effervescence; slightly alkaline; gradual wavy boundary.

C—48 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; many medium prominent strong brown (7.5YR 5/8) and common fine prominent light brownish gray (10YR 6/2) mottles; massive; hard, firm; common fine brown (7.5YR 4/2) accumulations of iron and manganese oxide; about 5 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 28 inches
Depth to carbonates: 20 to 34 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR, 2.5Y, or neutral
Value—3 to 5 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly loam; silt loam or clay loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 to 4
Texture—dominantly loam; silt loam or clay loam in some pedons

Bk horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 8 (4 to 6 moist)
Chroma—1 to 4
Texture—loam or clay loam

C horizon:
Hue—2.5Y
Value—5 or 6 (4 or 5 moist)
Chroma—2 to 4
Texture—loam or clay loam

Tetonka Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Tetonka silt loam, 2,100 feet north and 780 feet east of the southwest corner of sec. 34, T. 113 N., R. 58 W.

A—0 to 7 inches; gray (10YR 5/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; many very fine and fine roots; common very fine vesicular and few fine tubular pores; slightly acid; clear smooth boundary.

E—7 to 12 inches; gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) moist; few fine distinct light yellowish brown (10YR 6/4) mottles; weak thin platy structure parting to weak very fine granular; soft, very friable; many very fine and fine roots; common very fine vesicular and tubular pores; slightly acid; abrupt wavy boundary.

Bt1—12 to 23 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; strong medium prismatic structure parting to moderate fine subangular blocky; very hard, firm, sticky and plastic; common very fine roots between peds; few very fine and fine vesicular and tubular pores; slightly acid; shiny films on faces of peds; clear smooth boundary.

Bt2—23 to 33 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, firm, sticky and plastic; common very fine roots; few very fine and fine vesicular and tubular pores; shiny films on faces of peds; slightly acid; clear smooth boundary.

Bkg—33 to 44 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine prominent light yellowish brown (10YR 6/4) mottles; weak and moderate medium prismatic structure parting to weak fine subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine vesicular and common tubular pores; very few distinct very dark gray (10YR 3/1) accumulations of iron and manganese oxide in root channels or pores or both; common fine and medium rounded soft masses of carbonate; strong effervescence; neutral; clear smooth boundary.

Cg—44 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine prominent yellow (10YR 7/6), common distinct very dark gray (10YR 3/1), and common coarse prominent brown (7.5YR 4/4) mottles; massive; hard, friable, slightly sticky and slightly plastic; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 24 to 50 inches
Depth to carbonates: 30 to more than 60 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 50 to more than 60 inches

A horizon:
Hue—10YR
Value—4 or 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly silt loam; silty clay loam in some pedons

E horizon:
Hue—10YR
Value—5 to 7 (3 to 5 moist)
Chroma—1 or 2
Texture—dominantly silt loam; loam or silty clay loam in some pedons

Bt horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—4 to 6 (2 to 4 moist)
Chroma—0 to 2
Texture—clay, silty clay, silty clay loam, or clay loam

Bk horizon:
Hue—2.5Y, 5Y, or neutral
Value—5 to 7 (4 or 5 moist)
Chroma—0 to 2

Texture—clay loam, silty clay loam, clay, or silty clay

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—1 to 4
Texture—dominantly silty clay, silty clay loam, clay, or clay loam; stratified sandy loam or loam in some pedons

Tonka Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Tonka silty clay loam, 1,400 feet north and 2,080 feet west of the southeast corner of sec. 1, T. 119 N., R. 56 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; slightly acid; abrupt smooth boundary.

A—9 to 14 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; slightly acid; abrupt smooth boundary.

E—14 to 24 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; few fine prominent dark brown (7.5YR 3/2) mottles; moderate thin platy and moderate fine subangular blocky structure; slightly hard, soft, very friable; common very fine roots; common fine and very fine tubular pores; moderately acid; abrupt wavy boundary.

Bt1—24 to 40 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; few fine prominent strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; few very fine roots; shiny films on faces of peds; neutral; gradual wavy boundary.

Bt2—40 to 46 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; few fine prominent dark brown (7.5YR 3/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; few very fine roots; shiny films on faces of peds; slightly acid; gradual wavy boundary.

BCg—46 to 53 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct dark gray (N 4/0) and few fine prominent strong brown (7.5YR 4/6) mottles; weak medium subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; neutral; clear wavy boundary.

Cg—53 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine prominent strong brown (7.5YR 4/6) mottles; massive; very hard, friable, slightly sticky and slightly plastic; neutral.

Range in Characteristics

Thickness of the mollic epipedon: 20 to 50 inches
Depth to carbonates: 20 to more than 60 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: Greater than 60 inches
Other features: Some pedons have a Bk horizon, and some pedons do not have a BC horizon.

A horizon:
Hue—10YR or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silty clay loam; silt loam, loam, or clay loam in some pedons

E horizon:
Hue—10YR, 2.5Y, or neutral
Value—5 to 7 (3 to 5 moist)
Chroma—0 to 2
Texture—loam, silt loam, very fine sandy loam, or silty clay loam

Bt horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 5 (2 to 4 moist)
Chroma—1 or 2
Texture—clay loam, silty clay loam, silty clay, or clay

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—3 to 7 (2 to 6 moist)
Chroma—1 to 6
Texture—dominantly silty clay loam, clay loam, or loam; silty clay, clay, silt loam, or sandy clay loam in some pedons

Vallers Series

Depth to bedrock: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Loamy glacial till
Slope: 0 to 2 percent

Typical Pedon

Vallers loam, in an area of Vallers-Hamerly loams, 1,800 feet south and 400 feet east of the northwest corner of sec. 2, T. 116 N., R. 58 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate fine subangular blocky structure parting to moderate fine granular; slightly hard, friable; common roots; about 2 percent pebbles; strong effervescence (about 9 percent calcium carbonate equivalent); slightly alkaline; abrupt smooth boundary.

A—6 to 11 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate fine subangular blocky structure parting to moderate medium granular; slightly hard, friable; few roots; few fine and very fine tubular pores; very few fine accumulations of carbonate; about 2 percent pebbles; strong effervescence (about 11 percent calcium carbonate equivalent); slightly alkaline; abrupt wavy boundary.

Bk—11 to 18 inches; light brownish gray (10YR 6/2) clay loam, olive gray (5Y 4/2) moist; few fine prominent reddish yellow (7.5YR 6/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few roots; few fine and very fine tubular pores; very few fine accumulations of carbonate; about 2 percent pebbles; violent effervescence (about 22 percent calcium carbonate equivalent); moderately alkaline; clear wavy boundary.

Bkg—18 to 34 inches; gray (5Y 6/1) clay loam, olive gray (5Y 4/2) moist; few fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and common very fine tubular pores; common fine accumulations of carbonate; about 4 percent pebbles; violent effervescence (about 23 percent calcium carbonate equivalent); slightly alkaline; gradual wavy boundary.

Cg1—34 to 45 inches; gray (5Y 6/1) clay loam, olive gray (5Y 4/2) moist; many fine prominent strong brown (7.5YR 5/8) and few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; about 4 percent pebbles; strong effervescence (about 12 percent calcium carbonate equivalent); slightly alkaline; gradual wavy boundary.

Cg2—45 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/3) moist; many fine prominent light gray (10YR 7/1) and strong brown (7.5YR 5/6) mottles; massive; very hard, friable, slightly sticky and slightly plastic; common fine black (N 2.5/0) accumulations of iron and manganese oxide; few fine accumulations of carbonate; about 4 percent pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 25 inches
Depth to carbonates: 0 to 8 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 20 to more than 60 inches

A horizon:
- Hue—10YR, 2.5Y, 5Y, or neutral
- Value—3 or 4 (2 or 3 moist)
- Chroma—0 or 1
- Texture—dominantly loam; silt loam, clay loam, sandy clay loam, or silty clay loam in some pedons

Bk or Bkg horizon:
- Hue—10YR, 2.5Y, 5Y, or neutral
- Value—4 to 7 (3 to 6 moist)
- Chroma—0 to 2
- Texture—clay loam, silty clay loam, loam, or sandy clay loam

Cg horizon:
- Hue—2.5Y or 5Y
- Value—5 to 8 (4 to 7 moist)
- Chroma—1 to 3
- Texture—loam or clay loam

Waubay Series

Depth to bedrock: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Till plains
Parent material: Silty glacial till
Slope: 0 to 6 percent

Typical Pedon

Waubay silty clay loam (fig. 18), in an area of Poinsett-Rusklyn-Waubay silty clay loams, 1 to 6 percent slopes, 2,580 feet north and 2,500 feet west of the southeast

corner of sec. 35, T. 115 N., R. 56 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; many very fine roots; slightly acid; abrupt smooth boundary.

A—8 to 12 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, friable; many very fine roots; few fine and very fine tubular pores; neutral; clear smooth boundary.

Bw1—12 to 17 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable; common very fine roots; common fine and very fine tubular pores; neutral; clear wavy boundary.

Bw2—17 to 23 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; common very fine roots; common fine and very fine tubular pores; slightly alkaline; clear wavy boundary.

Bk—23 to 39 inches; light yellowish brown (2.5Y 6/3) silt loam, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; few very fine roots; many fine and very fine tubular pores; many fine soft masses of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C1—39 to 53 inches; light gray (2.5Y 7/2) and grayish brown (2.5Y 5/2) silt loam, light olive brown (2.5Y 5/4) moist; few fine prominent brownish yellow (10YR 6/6) mottles; massive; slightly hard, friable; common fine and many very fine tubular pores; few fine soft masses of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—53 to 60 inches; light gray (2.5Y 7/2) and grayish brown (2.5Y 5/2) silt loam, light olive brown (2.5Y 5/4) moist; common fine prominent brownish yellow (10YR 6/6) mottles; massive; slightly hard, friable; few fine and common very fine tubular pores; thin layers of fine sand; few fine soft masses of carbonate; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 16 to 35 inches
Depth to carbonates: 20 to 36 inches
Depth to contrasting or impervious layer: 40 to more than 60 inches over loamy glacial till
Depth to gypsum and other salts: Greater than 60 inches

A horizon:
Hue—10YR
Value—3 or 4 (2 or 3 moist)
Chroma—1
Texture—dominantly silty clay loam; silt loam in some pedons

Bw horizon:
Hue—10YR or 2.5Y
Value—3 to 5 (3 or 4 moist)
Chroma—1 to 3
Texture—silt loam or silty clay loam

Bk horizon:
Hue—2.5Y
Value—5 or 6 (4 or 5 moist)
Chroma—2 to 4
Texture—silt loam or silty clay loam

C horizon:
Hue—2.5Y or 5Y
Value—5 to 7 (4 to 6 moist)
Chroma—2 to 4
Texture—dominantly silt loam, silty clay loam, or loam; very fine sandy loam, fine sand, or clay in some pedons

Worthing Series

Depth to bedrock: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Local clayey alluvium
Slope: 0 to 1 percent

Typical Pedon

Worthing silty clay loam, 700 feet south and 2,020 feet west of the northeast corner of sec. 33, T. 113 N., R. 58 W.

A1—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine vesicular and tubular pores; neutral; clear smooth boundary.

A2—6 to 20 inches; dark gray (5Y 4/1) silty clay loam, black (5Y 2.5/1) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine vesicular and tubular pores; neutral; clear smooth boundary.

Bt—20 to 40 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate coarse

prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common very fine and fine roots between peds; few very fine vesicular and tubular pores; many shiny films on faces of peds; neutral; gradual smooth boundary.

Btkg1—40 to 49 inches; dark gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; few very fine and fine roots; few very fine vesicular and tubular pores; many shiny films on faces of peds; strong effervescence; slightly alkaline; gradual smooth boundary.

Btkg2—49 to 54 inches; gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; few very fine and fine roots; few very fine vesicular and tubular pores; many shiny films on faces of peds; strong effervescence; slightly alkaline; gradual smooth boundary.

Cg—54 to 60 inches; light gray (5Y 7/2) clay loam, olive gray (5Y 5/2) moist; common fine prominent yellowish brown (10YR 5/6), many faint gray (5Y 6/1), and common prominent dark yellowish brown (10YR 3/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; few very fine vesicular and tubular pores; few very dark brown (10YR 2/2) accumulations of iron and manganese oxide; common fine and medium irregular gypsum crystals; about 2 percent pebbles; strong effervescence; slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 35 to 60 inches
Depth to carbonates: 35 to 60 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 35 to more than 60 inches
Other features: A Bg horizon in some pedons

A horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 or 4 (2 or 3 moist)
Chroma—0 or 1
Texture—dominantly silty clay loam; silt loam or silty clay in some pedons

Bt horizon:
Hue—10YR, 2.5Y, 5Y, or neutral
Value—3 to 7 (2 to 5 moist)
Chroma—0 or 1
Texture—silty clay or clay

Cg horizon:
Hue—2.5Y, 5Y, or neutral
Value—4 to 8 (3 to 6 moist)
Chroma—0 to 2
Texture—silty clay, clay, silty clay loam, or clay loam

Wyndmere Series

Depth to bedrock: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Loamy glaciofluvial sediments
Slope: 0 to 3 percent

Typical Pedon

Wyndmere fine sandy loam, in an area of Wyndmere-Parnell complex, 1,220 feet south and 2,080 feet west of the northeast corner of sec. 18, T. 117 N., R. 57 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; few very fine and fine roots; strong effervescence (about 9 percent calcium carbonate equivalent); slightly alkaline; abrupt smooth boundary.

Bk1—7 to 14 inches; gray (10YR 5/1) fine sandy loam, dark gray (10YR 4/1) moist; weak medium subangular blocky structure; slightly hard, very friable; few very fine and fine roots; few fine vesicular and tubular pores; violent effervescence (about 19 percent calcium carbonate equivalent); slightly alkaline; clear wavy boundary.

Bk2—14 to 28 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable; few very fine roots; common fine vesicular and tubular pores; violent effervescence (about 16 percent calcium carbonate equivalent); moderately alkaline; clear wavy boundary.

C1—28 to 46 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; common fine distinct olive yellow (2.5Y 6/6) and prominent light gray (10YR 7/1) mottles; single grain; soft, very friable; common fine vesicular and tubular pores; strong effervescence (about 13 percent calcium carbonate equivalent); moderately alkaline; clear wavy boundary.

C2—46 to 60 inches; light yellowish brown (2.5Y 6/4) loamy very fine sand, light olive brown (2.5Y 5/4) moist; few fine prominent light gray (10YR 7/1) and few medium prominent yellowish brown (10YR 5/6) mottles; single grain; soft, loose; few fine vesicular

and tubular pores; few medium rounded soft masses of carbonate; strong effervescence (about 11 percent calcium carbonate equivalent); slightly alkaline.

Range in Characteristics

Thickness of the mollic epipedon: 7 to 16 inches
Depth to carbonates: 0 to 7 inches
Depth to contrasting or impervious layer: Greater than 60 inches
Depth to gypsum and other salts: 40 to more than 60 inches

A horizon:
Hue—10YR
Value—3 to 5 (2 or 3 moist)
Chroma—1 or 2
Texture—dominantly fine sandy loam; sandy loam, very fine sandy loam, silt loam, or loam in some pedons

Bk horizon:
Hue—10YR or 2.5Y
Value—4 to 8 (3 to 6 moist)
Chroma—1 to 4
Texture—fine sandy loam or sandy loam

C horizon:
Hue—10YR, 2.5Y, or 5Y
Value—5 to 8 (4 to 7 moist)
Chroma—2 to 6
Texture—dominantly fine sandy loam, sandy loam, loamy very fine sand, loamy sand, or loamy fine sand; silt loam, loam, or fine sand in some pedons

Formation of the Soils

Soil forms when chemical and physical processes act on geologically deposited or accumulated material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are modified by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil having genetically related horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. The following paragraphs relate the factors of soil formation to the soils in Clark County.

Climate

Climate directly influences the rate of chemical and physical weathering. Clark County has a continental climate marked by cold winters and hot summers. This climate favors the growth of grasses and the resulting accumulation of organic matter in the upper part of the soil. It also favors a moderately slow rate of weathering or soil formation. The climate in the eastern part of the county is somewhat wetter than that in the western part, and thus it has been a factor in differentiating some of the soils. Detailed information about the climate is given under the heading "General Nature of the County."

Plant and Animal Life

Plants, animals, insects, earthworms, bacteria, and fungi have an important effect on soil formation. They cause gains in organic matter, gains or losses in plant nutrients, and changes in soil structure and porosity. In Clark County the prairie grasses have had more influence than other living organisms on soil formation. In areas that support these grasses, the surface layer of many soils has a moderate content of organic matter. The gently sloping Aastad soils contain more organic matter than the more sloping Buse soils because the Aastad soils have a more extensive grass cover.

Earthworms, insects, and burrowing animals help to keep the soil open and porous. Bacteria and fungi decompose plant residue, thus releasing nutrients that plants utilize.

Parent Material

Parent material is the unconsolidated organic and mineral material in which a soil forms. It determines many of the chemical and physical characteristics of the soil, such as color, texture, reaction, and consistence. The rate of soil formation is more rapid in the more friable, loamy and silty parent material than in other kinds of parent material. Also, more changes take place and the horizons are more distinct.

Most of the soils in Clark County formed in deposited material derived from preglacial formations of granite, gneiss, limestone, quartzite, sandstone, and shale. The glacier ground up and mixed these materials as it transported them (Christensen, 1987). It then redeposited them as it melted. Some deposits are unsorted material, or glacial till; others are material sorted either by water during deposition or by wind and water after deposition. Still others formed in older alluvial deposits on high flood plains or in recent alluvial deposits on low flood plains and in basins on plains and moraines.

The glacial till in Clark County can generally be classified as loamy glacial till or silty glacial till. The silty

glacial till is mainly throughout the eastern part of the county on the Coteau des Prairies. The loamy glacial till is mainly in the western part of the county, both on the Coteau des Prairies and on the James Basin below the Coteau. Much of the glacial till on the James Basin is much firmer than that in other areas and contains more clay. Loamy glacial till is also intermixed with areas of silty glacial till. The loamy glacial till generally has scattered stones and boulders throughout.

The silty glacial till was deposited on glacial ice and then reworked by water as the glacier melted. Poinsett and Waubay soils formed in silty glacial till. Loamy glacial till is a mixture of clay, silt, sand, and gravel and few to many stones and boulders. It has a higher content of stones and boulders than the silty glacial till. Barnes, Forman, and Buse soils formed in loamy glacial till.

Loess is wind-deposited material that is mainly silt and very fine sand. In Clark County the loess is not always easily distinguished from silty glacial till. Much of the wind-deposited material may be reworked by water, and areas of silty glacial till may be blanketed with thin layers of windblown material. The thicker areas of loess are generally on the leeward side of meltwater deposits in the northern and central parts of the county. Kranzburg and Rusklyn soils formed in a thin mantle of loess over loamy glacial till.

Glacial outwash is sandy, gravelly, and loamy material deposited by glacial meltwater. Fordville and Renshaw soils formed in loamy material underlain by sand and gravel within a depth of 40 inches. Most of the soils that formed in glacial outwash are in a narrow band that runs from north to south through the central part of the county. Other areas of outwash are along high outwash terraces on the western edge of the Coteau des Prairies and in the northern areas of the county south of the terminal moraine.

Alluvium is recently deposited sandy to clayey material on flood plains and in basins. La Prairie, Lowe, and Rauville soils formed in stream-deposited alluvium. Parnell, Southam, and Tonka soils formed in local alluvium in basins on plains and moraines.

Relief

Relief affects drainage, runoff, erosion, plant cover, and soil temperature. Buse and Langhei soils, for example, lose much rainfall because of runoff. As a result of the runoff rate, a limited amount of moisture penetrates the surface and much soil is lost through erosion. These soils are calcareous at or near the surface. The layers in which organic matter accumulates are thin. In areas where the runoff rate is slower, such as areas of Poinsett and Barnes soils, more moisture penetrates the surface and the layers in which organic matter accumulates are thicker. Calcium carbonate is leached to a depth of more than 8 inches. Aastad and Waubay soils are on foot slopes that receive extra moisture in the form of runoff from adjacent soils. The layers in which organic matter accumulates are thicker in these soils than those in the Barnes and Poinsett soils, and calcium carbonate is leached to a greater depth. The seasonal high water table in Lowe and Vallers soils favors the concentration of calcium carbonate.

Time

The length of time that soil material has been exposed to the other four factors of soil formation is reflected in the kinds of soil that form. All of the soils in Clark County are relatively young. Generally, the degree of profile development reflects the age of a soil. The oldest soils are on the parts of the landscape that have been stable for the longest time. These are Forman and Peever soils, which have developed distinct horizons. The youngest soils either are those in which natural erosion removes nearly as much soil material as is formed through the weathering of parent material or are alluvial soils, which receive new material each time the area is flooded. Rusklyn and Buse soils are young soils that are subject to natural erosion. Fairdale and Rauville soils are examples of young alluvial soils.

References

American Association of State Highway and Transportation Officials (AASHTO). 1986. Standard specifications for highway materials and methods of sampling and testing. 14th edition, 2 volumes.

American Society for Testing and Materials (ASTM). 1993. Standard classification of soils for engineering purposes. ASTM Standard D 2487.

Centennial History of Clark County, South Dakota, 1881-1981. 1981.

Christensen, C.M. 1987. Geology and water resources of Clark County, South Dakota. Part I: Geology. South Dakota Geological Survey Bulletin 29.

Flint, Richard Foster. 1955. Pleistocene geology of eastern South Dakota. U.S. Geological Survey, Professional Paper 262.

Hamilton, Louis J. 1986. Geology and water resources of Clark County, South Dakota. Part II: Water resources. South Dakota Geological Survey Bulletin 29.

United States Department of Agriculture. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210.

United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conservation Service, U.S. Department of Agriculture Handbook 436.

United States Department of Agriculture. 1987. National resources inventory, county base data. Soil Conservation Service.

United States Department of Agriculture. 1993. Soil survey manual. U.S. Department of Agriculture Handbook 18.

United States Department of Commerce, Bureau of the Census. 1987. 1987 census of agriculture.

United States Department of Commerce, Bureau of the Census. 1991. 1990 census of population and housing—Summary population and characteristics of South Dakota.

Glossary

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.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Back slopes are commonly steep and linear and descend to a foot slope. Back slopes are erosional forms produced mainly by mass wasting and running water.

Basin. A depressed area with no surface outlet. Examples include closed depressions on a glacial till plain and lake basins.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

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.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles 2 millimeters to 38 centimeters (15 inches) long.

Colluvium. Soil material or 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 establishing terraces, diversions, and other water-control structures 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.

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

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers.

Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour farming. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

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.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

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, soil. The thickness of weathered soil material over bedrock. The depth classes recognized in this survey are:

Very deep	more than 60 inches
Deep	40 to 60 inches
Moderately deep	20 to 40 inches
Shallow	less than 20 inches

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the

soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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

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 human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salt (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

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

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or

lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

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

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.

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

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landform. Any physical, recognizable form or feature of

the earth's surface having a characteristic shape and produced by natural causes.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the 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.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) having high base saturation and pedogenic soil structure. It may include some of the subsoil.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

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 three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to adversely affect the physical condition of the subsoil.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Pasture, tame. Grazingland planted primarily to introduced or domesticated native forage species. It receives periodic renovation and cultural treatment, such as tillage, fertilization, mowing, weed control, and irrigation.

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 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as 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. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, 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.

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.

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 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 degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly 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.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

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 underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The uppermost inclined surface at the top of a hillslope. The transition zone from back slope to summit of an upland. Dominantly convex in profile and erosional in origin.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The slope classes recognized in this survey area are as follows:

Level	0 to 1 percent
Nearly level	0 to 2 percent
Very gently sloping or gently undulating	1 to 4 percent

Gently sloping or undulating	2 to 6 percent
Moderately sloping or gently rolling	6 to 9 percent
Strongly sloping or rolling	9 to 15 percent
Moderately steep or hilly	15 to 25 percent
Steep or very hilly	25 to 45 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

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.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

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 erosion 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 grain* (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 wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The top or highest level of an upland feature. A high interfluve area of gentler slope that is flanked by steeper hillslopes.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

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). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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.

Transitional layer. A layer of soil that grades to the next layer or includes parts of adjacent layers, commonly between the surface layer and the subsoil or underlying layer.

Underlying layer. The C horizon or R layer; that part of the soil below the subsoil, commonly the parent material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.