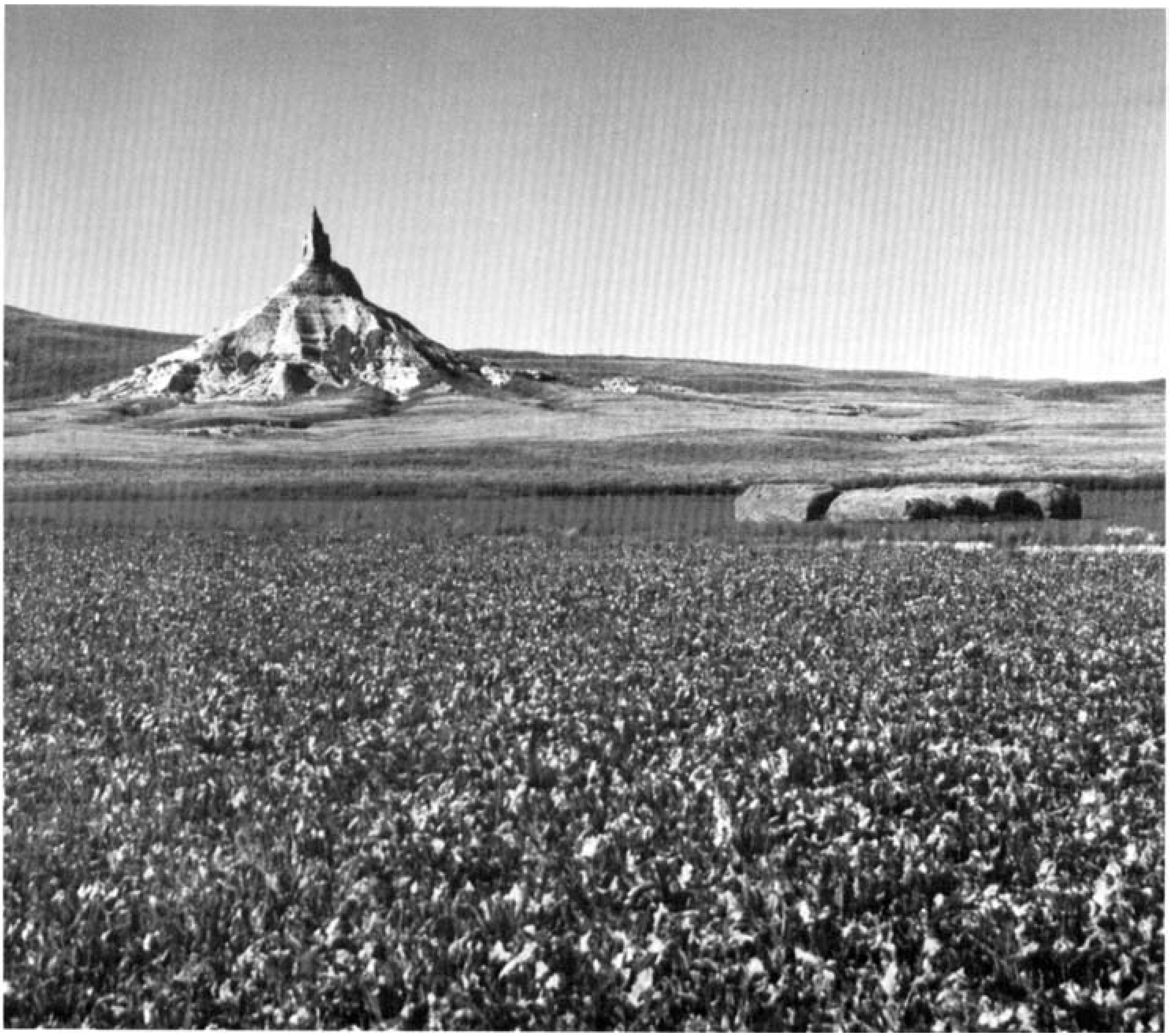
United States Department of Agriculture

Soil Conservation Service

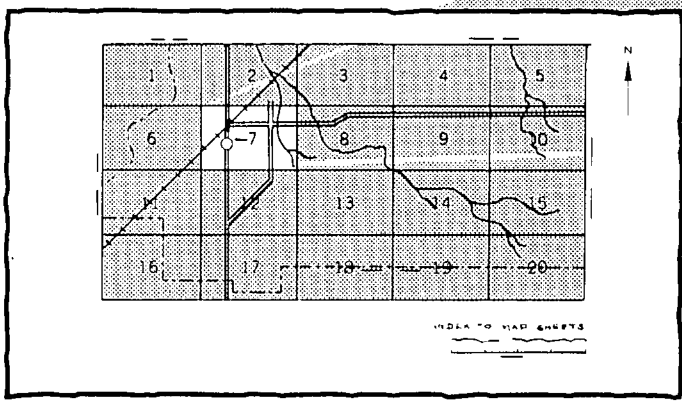
In cooperation with University of Nebraska, Conservation and Survey Division

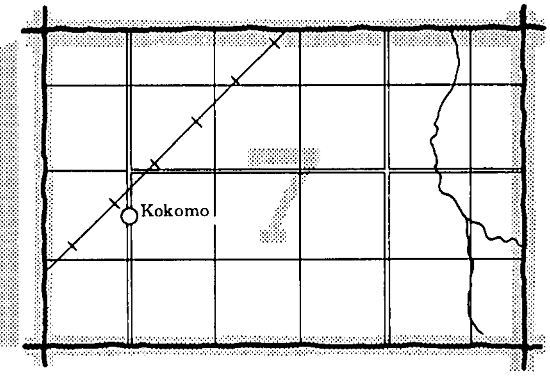
Soil Survey of Morrill County Nebraska



HOW TO USE

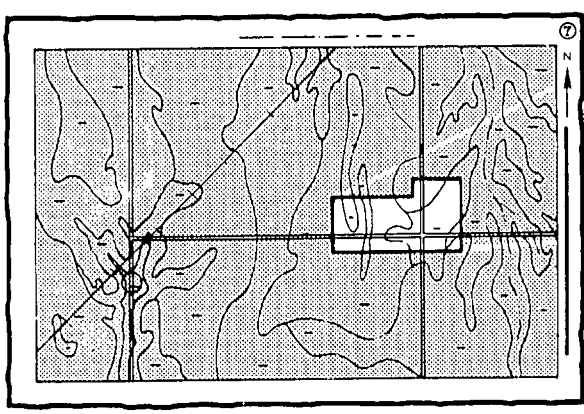
1. Locate your area of interest on the "Index to Map Sheets."

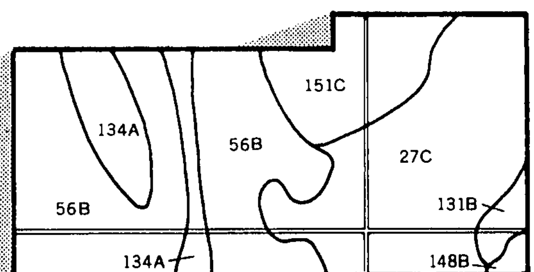




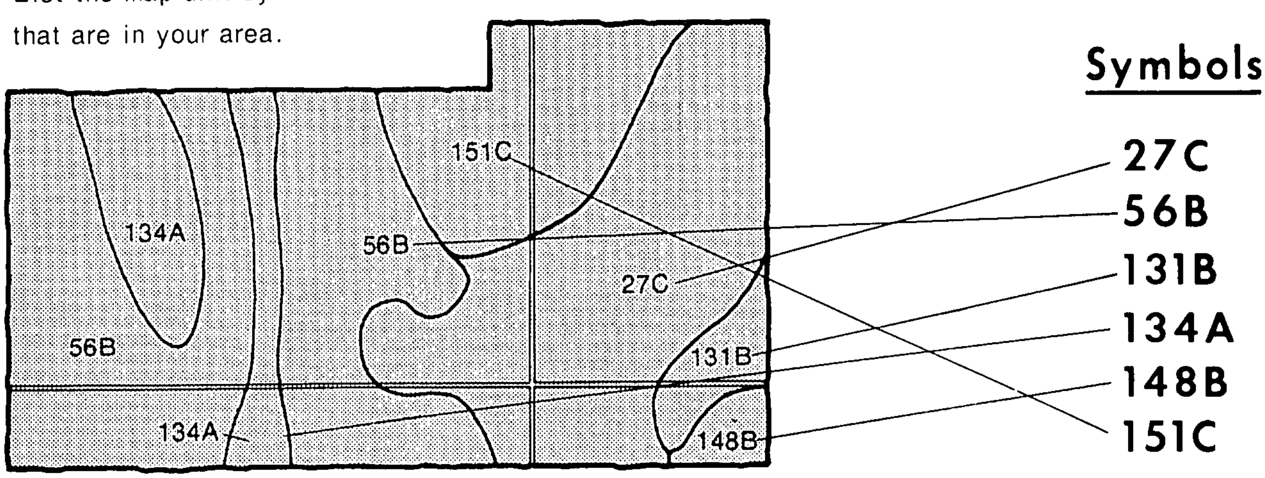
2. Note the number of the map sheet and turn to that sheet.

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



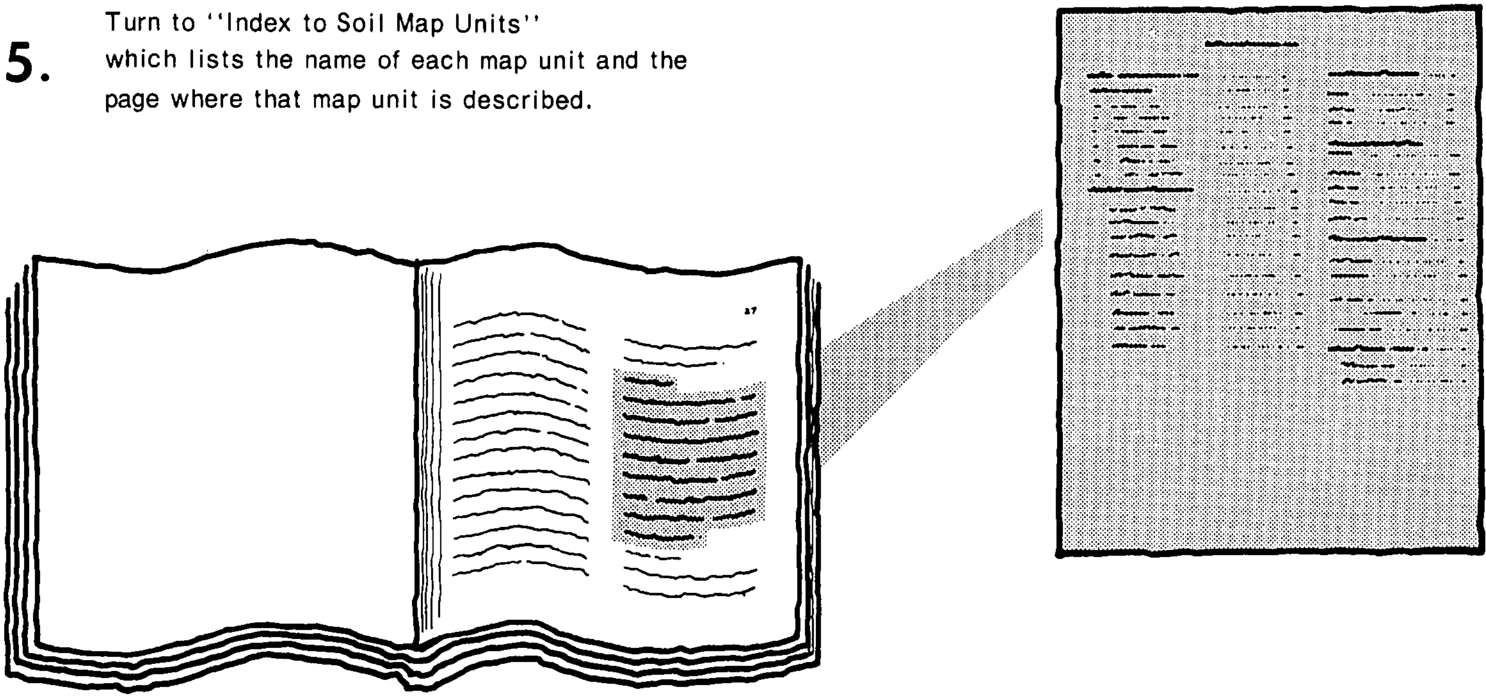


4. List the map unit symbols that are in your area.

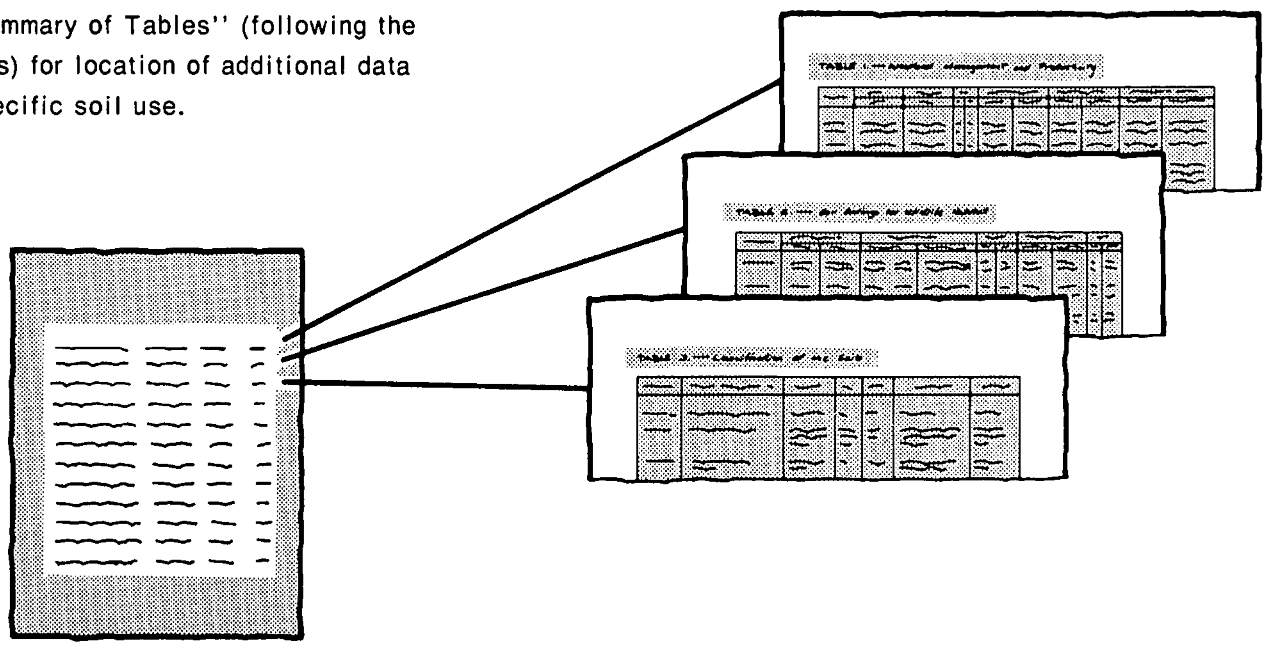


THIS SOIL SURVEY

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



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



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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and the University of Nebraska, Conservation and Survey Division. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1980. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980. This survey was made by the Soil Conservation Service in cooperation with the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the North Platte Natural Resources District.

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

This soil survey supersedes a soil survey of Morrill County published in 1920.

Cover: Sugar beets in an area of Yockey silt loam, 0 to 1 percent slopes. Chimney Rock in the background is a well-known landform on the historical Oregon Trail.

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Soil Series

Issued August 1985

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Summary of Tables

Foreword

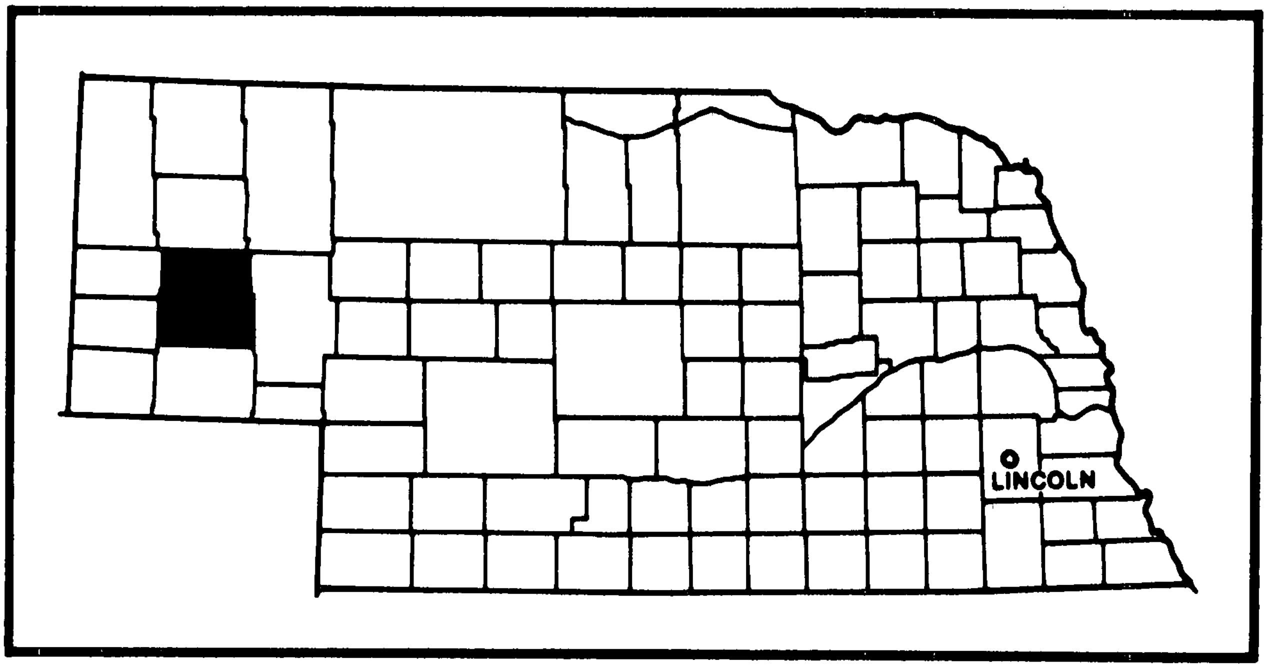
This soil survey contains information that can be used in land-planning programs in Morrill County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact 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 insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

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

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

Sherman L. Lewis
State Conservationist
Soil Conservation Service



Location of Morrill County in Nebraska.

Soil Survey of
Morrill County, Nebraska

By Norman P. Helzer, Dale R. Gengenbach, J. Cameron Loerch,
Gary L. McCoy, and Rita S. Dallavalle,
Soil Conservation Service

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

MORRILL COUNTY is in the heart of the panhandle in western Nebraska. It is approximately 38 miles wide from east to west and 39 miles long from north to south and takes in an area of 900,808 acres. Bridgeport is the largest town and the county seat.

The population of Morrill County was 6,132 in 1980. Most residents work in agriculture-related jobs or earn their living by farming or ranching.

Farming and ranching are the main economic enterprises in the county. Corn, sugar beets, dry edible beans, and alfalfa are the main irrigated crops; winter wheat is the main crop grown under dry farming. Approximately 75 percent of the total land area is in native grasses, which are used either for range or hay.

The soils in the sandhills and on dunes in the river valley formed in eolian sand. They are suited to use as rangeland. Soil blowing is the main hazard.

The major soils on the upland breaks formed in material that weathered from sandstone bedrock. These are loamy soils, and they are suited to use as rangeland. They are generally too shallow and too steep for cultivation.

There are deep, well drained loamy soils on valley foot slopes, stream terraces, and uplands. The more gently sloping soils are suited to cultivated crops under dry farming, and the nearly level soils are suited to cultivated crops under irrigation. Water erosion is the main hazard.

There are sandy and loamy soils on uplands and stream terraces. The sandy soils are best suited to use as rangeland. The very gently sloping and nearly level loamy soils are best suited to cultivated crops under dry farming. If irrigation is used, however, a sprinkler system is most efficient on these soils. Soil blowing and water erosion are hazards.

There are some soils of lesser extent on bottom lands. The soils formed in alluvium. They are silty, loamy, and sandy. Most of these soils are best suited to use as rangeland. A few soils are suited to either dry-farmed or irrigated crops. Wetness caused by a seasonal high water table is a limitation. Many soils also are affected by saline-alkali characteristics. Flooding and soil blowing are the main hazards.

General Nature of the County

This section provides general information about Morrill County. It briefly discusses history; agriculture and industry; trends in agriculture; transportation; physiography, relief, and drainage; geology; ground water; climate.

History

The first travelers who passed through what is now Morrill County were Astorian fur trappers traveling from Oregon in 1812 on the North Platte River *(15)*. The Oregon Trail was established in 1836 when immigrants to Oregon traveled along the Platte River. Courthouse Rock, Jail Rock, and Chimney Rock marked the beginning of the mountains for these travelers. In 1849, California gold seekers also traveled the Oregon Trail.

Soon after the Union Pacific Railroad reached Sidney in 1867, large cattle ranches were established in Morrill County. Farming came to Morrill County in about 1885.

The Herd Law in 1887 marked the end of open range and the beginning of farming as an important business.

The discovery of gold in the Black Hills in 1874 brought more immigrants through Morrill County. In 1875, H. T. Clarke built the first bridge across the North Platte River on the Sidney-Deadwood Trail in western Nebraska. In 1890, the Burlington Railroad built a bridge across the North Platte River, and soon after that the city of Bridgeport sprang up.

On March 9, 1909, Morrill County was established from a part of Cheyenne County. Because of its centered location, Bridgeport became the county seat.

Agriculture and Industry

Agriculture and related industries form the economic base for Morrill County. The North Platte Irrigation Project has made it possible to raise irrigated crops in the valley. The major crops grown are sugar beets, dry edible beans, corn, and alfalfa. Winter wheat is grown without irrigation in a fallow-wheat rotation. Certified grass seed and potatoes are also grown.

Many ranches have a cow-calf operation. The calves are sold in the fall as feeders. On some ranches, horses are raised and trained.

Farm implement dealers in Bridgport serve much of western Nebraska as well as many of the adjacent states. Grain or bean elevators are located in all of the communities in the county. A sugar beet factory in Bayard has its own lime kiln and refines sugar to be sold nationwide. Other industries, including a growing oil industry and tourism contribute to the local economy. Morrill County is one of Nebraska's largest producers of sand and gravel. Two railroads provide work for many. Morrill County has a number of building contractors for construction needs.

Adequate shopping areas serve the residents of the county.

Trends in Agriculture

Prior to the development of the North Platte Irrigation Project, raising and selling livestock was the main agricultural enterprise in Morrill County. The project was completed in 1927, but the first water for irrigation use was released through the network of canals in 1908 *(9)*.

Corn was the first crop grown under irrigation in Morrill County. Irrigated sugar beets became an important crop after the construction of a sugar refinery in 1917. Dry edible beans became an important irrigated crop in about 1930. The largest acreage remains in summer fallow-winter wheat; but, with increasing use of commercial nitrogen fertilizer, irrigation, and climatically adapted hybrids, the corn acreage is nearly equal to that of winter wheat *(8)*.

The development of the center-pivot system of irrigation caused a rapid increase in the number of wells for irrigation. In 1968, there were 206 wells in the county. By 1978, there were 504 wells, and the acreage of irrigated land had increased by more than 32,000 acres *(6,7)*. The wells also supplement gravity irrigation in the North Platte River valley. In the sandhills, well water irrigates alfalfa and some corn.

The number of cattle on rangeland remained constant from 1958 through 1978, but the number of cattle on feed increased from 10,700 in 1962 to 25,200 in 1978 *(4,5,7)*. The number of sheep decreased until 1968, and the number of hogs increased. Since 1968 the numbers of sheep and hogs has remained unchanged.

The general trend in Morrill County is toward fewer farms of large acreage.

Transportation

Morrill County has access to good transportation, including commercial air service, in nearby Scottsbluff. Commercial truck service is available to all communities in the county. Two railroads cross the county and serve several towns, and busline service is available in some towns. Several landing strips are available for small aircraft.

Nebraska Highway 92 and U.S. Highway 26 are east-west all-weather highways, and U.S. Highway 385 crosses the county from north to south. Nebraska Highway 88 extends soutwest out of Bridgeport. All of these highways intersect at Brideport. The rural road system in the valley areas is well developed. Most roads are on section lines. Roads serving as rural mail routes and school bus routes have a gravel surface. Few roads are developed in the breaks and sandhills. Primitive roads and trails lead to most ranch headquarters in the sandhills.

Physiography, Relief, and Drainage

Morrill County is in the High Plains region of the Great Plains where tablelands have been dissected by ancient Horse Creek and the North Platte River *(3)*. Pumpkin Creek now flows through the valley that was cut by ancient streams. The maximum relief where the dissected tablelands break to the bottom lands is about 600 feet.

The uplands include the sandhills, tablelands, and breaks. The sandhills are in the northeastern part of the county. They make up about 28 percent of the county. Slopes range from nearly level to very steep. The tablelands are in two narrow areas along the breaks to the valleys. They make up about 10 percent of the county. Slopes range from nearly level to moderately steep. The breaks to the Pumpkin Creek valley and the North Platte River valley are dissected by drainageways and are very steep in many places. They make up about 22 percent of the county.

The North Platte River valley is as wide as 10 miles in the western part of the county. The valley foot slopes and high stream terraces make up about 33 percent of the county. Most slopes range from nearly level to moderately steep. Bottom lands make up about 7 percent of the county. Slopes generally are nearly level.

Most of the county is drained by the North Platte River and Pumpkin Creek, which flow toward the southeast. Many intermittent streams are tributaries of the North Platte River and Pumpkin Creek. In the sandhills there is a large closed basin, and generally there is no surface flow out of the basin. In this area there are many lakes, and most contain water that is mildly to strongly alkaline.

Elevation in the county ranges from 3,480 feet above sea level in the southeastern part to about 4,600 feet in the west central part. Bridgeport has an elevation of about 3,660 feet, and Bayard has an elevation of about 3,800 feet.

Geology

Prepared by Jim Swinehart, geologist, Conservation and Survey Division, University of Nebraska.

The oldest exposed rocks in Morrill County are pinkish to brown siltstone, belonging to the upper part of the Brule Formation of Oligocene age. The Brule Formation is exposed mainly along the lower slopes of the Platte River and Pumpkin Creek valleys. The silt particles are composed predominantly of volcanically derived material (volcanic ash) that is, primarily, angular shards of volcanic glass. The material was blown into the area from volcanic eruptions far to the west. There are also several beds of pure volcanic ash in the Brule Formation.

Overlying the Brule Formation, along the north side of the North Platte River valley west of Broadwater and in the Wildcat Ridge, is grayish, silty fine-grained sandstone of the Arikaree Group. Elongated, ledge-forming carbonate cemented concretions are common in these rocks. The sandstone is approximately 50 percent glass shards and other volcanic grains derived from western volcanoes. The Arikaree Group is mainly early Miocene in age.

The Ogallala Group overlies the Arikaree Group north of the North Platte River valley; elsewhere in the county the Ogallala Group rests on the Brule Formation. The Ogallala Group consists of a wide variety of lithologies that range from fine-grained siltstone to carbonate-cemented sandstone to coarse gravel. These materials often are deposited in old valleys that cut deeply into the underlying strata. The Ogallala Group contains some discrete beds of volcanic ash but, otherwise, is composed mostly of quartz, feldspar, and rock fragments that are derived from mountains to the west and transported to the site by rivers. The Ogallala Group is middle to late Miocene in age.

Overlying these older rocks are unconsolidated Quaternary deposits consisting of alluvial sand and gravel and windblown sand and silt. The oldest alluvium (the Broadwater Formation) is exposed high on the slopes of the North Platte River valley east of Broadwater. Younger sandy to gravelly alluvium underlies the terraces and bottom lands of the North Platte River and Pumpkin Creek valleys. Much of the northeast one-third of Morrill County is covered by the fine-grained sands of the Nebraska sandhills. This extensive sand dune field formed during very arid conditions in latest Quaternary time. There are several small areas of dune-sand accumulation in the North Platte River valley; one such area is between Chimney Rock and Court House Rock.

Ground Water

Prepared by the Conservation and Survey Division, University of Nebraska.

The Brule Formation underlies all of Morrill County. Very little water can be obtained from wells in this formation, except possibly where a well is drilled into joints or fractures. Such wells yield small to large amounts of water.

On the uplands east of Broadwater, the Arikaree Group is a source of water for irrigation and for domestic and livestock use. The Ogallala Group is the principal source of ground water on the uplands in the north-central and northwestern parts of the county and on the uplands south of the North Platte River valley and the Pumpkin Creek valley. The unconsolidated Quaternary deposits, consisting principally of sand and gravel, are the most important source of ground water in the valleys.

On the flood plain of the North Platte River valley, the depth to water ranges from 4 to 100 feet or more on the valley side slopes and up to 300 feet on the uplands.

The number of wells for irrigation that were registered in the county as of September 30, 1980, was 546. Of this number, 278 were used with a pivot irrigation system.

The ground-water supply adequately meets the needs for domestic and livestock uses throughout the county, except in a few areas where the Brule Formation is at or near the surface. Such areas are mainly in the North Platte River valley west and north of Bridgeport. The towns in Morrill County are located mainly in the North Platte River valley. Municipal wells derive adequate supplies of ground water from the valley alluvium. The greatest concentration of wells for irrigation is in the valley of the North Platte River and the valley of Pumpkin Creek and along a line that extends from about 6 miles north of Broadwater to the northwest corner of the county.

The water is of good quality throughout the county. The water is hard or very hard. In the sandhills, however, the water from shallow wells is soft to hard.

Contamination of the ground water is not currently a problem in Morrill County; however, the potential for contamination exists where there is a concentration of waste, as in a feedlot, a human waste disposal system, or where there is heavy use of fertilizers and agricultural chemicals. Sandy soils and soils that have a shallow water table are the most likely to develop ground-water contamination problems.

Newly established well systems that are intended for domestic use should be checked for nitric and bacterial content. Existing wells should be checked if a source of contamination is present.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Morrill County is usually warm in summer. Hot days are frequent. In winter, periods of very cold weather are caused by artic air moving in from the north or northeast. Cold periods alternate with milder periods that occur often when westerly winds are warmed as they move downslope. Most precipitation falls as rain during the warmer part of the year and is normally heaviest late in spring and early in summer. Snowfalls are frequent, but snow cover usually disappears during mild periods.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Bridgeport, Nebraska, in the period 1951 to 1973. 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 29 degrees F, and the average daily minimum temperature is 14 degrees. The lowest temperature on record, which occurred at Bridgeport on January 19, 1963, is -35 degrees. In summer the average temperature is 72 degrees, and the average daily maximum temperature is 88 degrees. The highest recorded temperature, which occurred on July 11, 1954, is 110 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 (40 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 average annual precipitation is 15.82 inches. Of this, 13 inches, or 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 11 inches. The heaviest 1-day rainfall during the period of record was 3.3 inches at Bridgeport on June 10, 1965. Thunderstorms occur on about 44 days each year, and most occur in summer.

The average seasonal snowfall is 31 inches. The greatest snow depth at any one time during the period of record was 13 inches. On an average of 15 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 45 percent. Humidity is higher at night, and the average at dawn is about 75 percent. The sun shines 75 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the west or west-northwest from October through April and from the east-southeast from May through September. Average windspeed is highest, 12 miles per hour, in spring.

In some years during winter, a heavy blizzard with high winds and drifting snow strikes the area, and snow remains on the ground for many weeks. In some years during summer, hailstones that fall during thunderstorms cause severe local damage to crops in the area.

How This Survey Was Made

This soil survey supersedes the soil survey of Morrill County published in 1920 (*10*). This survey provides additional information and contains larger maps that show the soils in greater detail.

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

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

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

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

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

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

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

Map Unit Composition

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

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

Dominantly sandy soils on sandhills and terraces

These are nearly level to very steep, somewhat poorly drained and excessively drained soils. Nearly all of the acreage is native-grass rangeland. Soil blowing is the main hazard.

1. Valentine Association

Deep, excessively drained, gently sloping to hilly, sandy soils that formed in eolian sand; on hummocks and dunes in the sandhills

This association consists mainly of soils on dunes in the sandhills (fig. 1). Slopes range from 3 to 60 percent.

This association takes in about 188,500 acres, or about 21 percent of the county. It is about 95 percent Valentine soils and 5 percent minor soils.

The Valentine soils are on hummocks, on smooth convex slopes on dunes, and on irregular and choppy slopes on dunes that, in some places, have a catstep surface. The surface layer is light brownish gray fine sand, and the transitional layer is very pale brown fine sand. The underlying material, which extends from a depth of 15 inches to a depth of 60 inches or more, is very pale brown fine sand.

The minor soils in this association are mainly the Dunday, Els, and Hoffland soils. Dunday soils are on low hummocks and concave foot slopes in enclosed sandhill valleys. Els soils are in slightly concave areas and on low slightly hummocky slopes in enclosed sandhill valleys. Hoffland soils are in nearly level areas in enclosed sandhill valleys.

Nearly all of the soils in this association are in native-grass rangeland. The soils generally are not suited to farming because of the steepness of the slopes and the hazard of soil blowing. In some places, access is difficult.

The use of the soils in this association as rangeland effectively controls soil blowing and water erosion. Concerns in management include proper grazing use, timely deferment of grazing, and a planned grazing system to help maintain or improve the range condition.

Ranches in this association, on the average, are about 2,000 acres in size. Some ranches, however, are as large as 50,000 acres. Most ranches have a cow-calf operation. Most calves are marketed in the fall as feeders; some are delivered to markets in adjacent counties.

2. Valentine-Els-Wildhorse Association

Deep, excessively drained and somewhat poorly drained, nearly level to steep, sandy soils that formed in eolian sand; on dunes and enclosed valleys in the sandhills

This association consists mainly of soils on dunes and in enclosed valleys in the sandhills. Slopes range from 0 to 30 percent.

This association takes in about 62,800 acres, or about 7 percent of the county. It is about 51 percent Valentine soils, 16 percent Els soils, 14 percent Wildhorse soils, and 19 percent minor soils.

The Valentine soils are gently sloping to steep; they are excessively drained. The soils are on hummocks and smooth convex slopes on dunes surrounding enclosed sandhill valleys. They have a surface layer of light brownish gray fine sand and a transitional layer of very pale brown fine sand. The underlying material, which extends from a depth of 15 inches to a depth of 60 inches or more, is very pale brown fine sand.

The Els soils are nearly level and are somewhat poorly drained. They are on slightly concave slopes and on low, slightly hummocky slopes in enclosed sandhill valleys. They have a surface layer of dark grayish brown fine sand and a transitional layer of grayish brown fine sand. The underlying material, which extends from a depth of 14 inches to a depth of 60 inches or more, is light brownish gray and light gray fine sand.

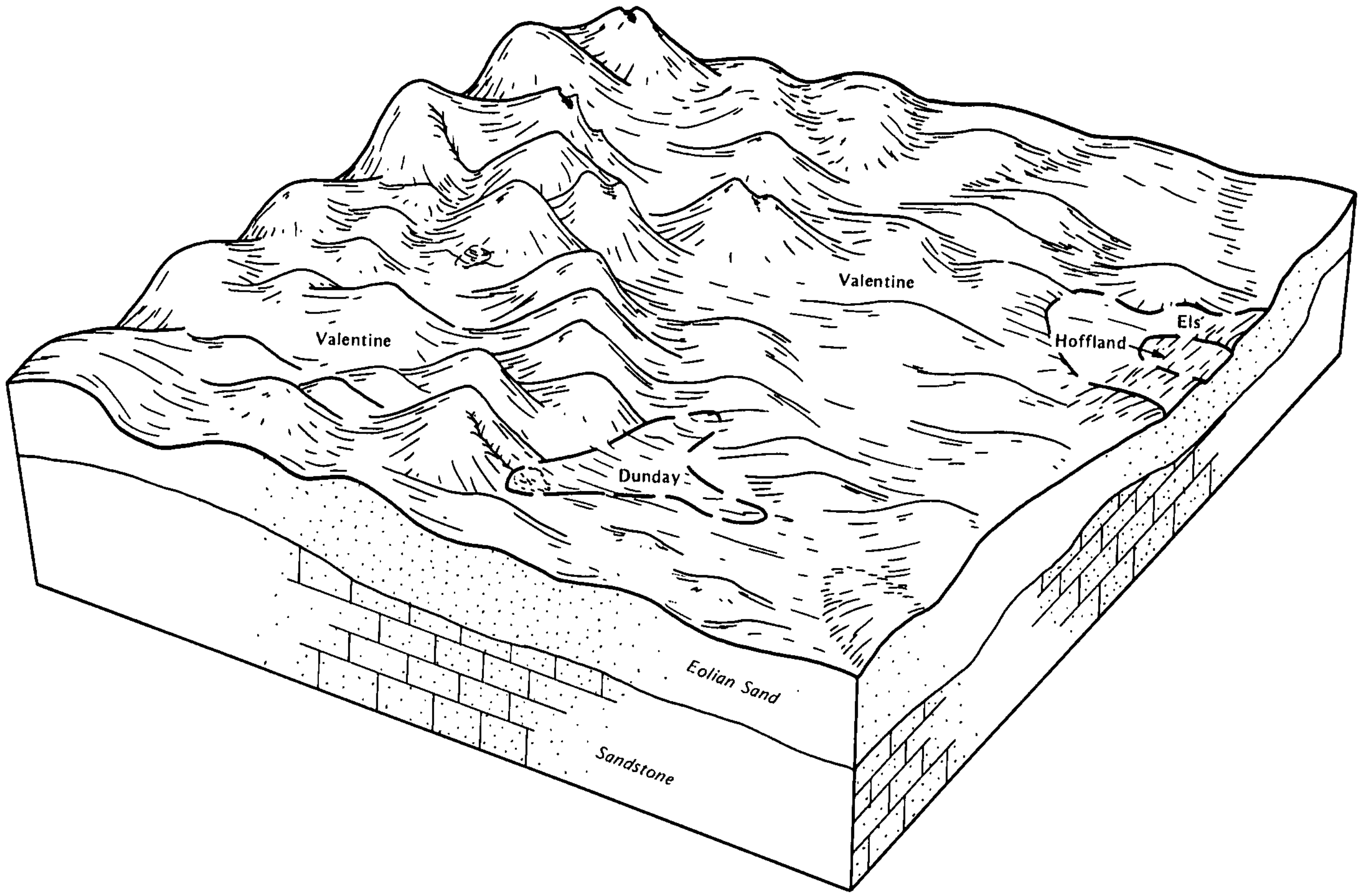


Figure 1.—Pattern of soils, topography, and underlying material in the Valentine association.

The Wildhorse soils are nearly level and are somewhat poorly drained. They are on concave slopes and on low, slightly hummocky slopes in enclosed sandhill valleys. They have a surface layer and subsurface layer of grayish brown and light brownish gray sand. The surface layer is strongly alkaline, and the subsurface layer is very strongly alkaline. The transitional layer is light brownish gray sand. It is very strongly alkaline. The underlying material, to a depth of 60 inches, is light brownish gray and light gray sand and fine sand. It is very strongly alkaline in the upper part and strongly alkaline in the lower part.

The minor soils in this association are mainly the Dunday and Hoffland soils. Dunday soils are on hummocks and concave foot slopes in enclosed sandhill valleys. Hoffland soils are in nearly level areas in enclosed sandhill valleys.

Nearly all of the soils in this association are in native grasses. On the moderately steep and steep soils, the grasses are used for grazing. On the saline-alkali soils and on the nearly level to gently sloping soils in enclosed valleys, the grasses are used mainly for hay.

Most ranches have a cow-calf operation. Grazing takes place from late in spring to early in fall. Calves are sold locally in the fall as feeders. Some are delivered to markets in adjacent counties. Native hay is the major feed supply during winter.

A small acreage is cultivated and irrigated by the sprinkler method. Alfalfa and corn are the principal crops.

The use of the soils in this association as rangeland and hayland effectively controls soil blowing and water erosion. Concerns in management include proper grazing use, proper mowing height, timely deferment of grazing or haying, and a planned grazing system to help maintain or improve the range. Proper haying time and restricted use during very wet periods help maintain the native plants in good condition.

Ranches in this association, on the average, are about 2,000 acres in size. Some areas within the association, however, are a part of ranches that range to 50,000 acres in size.

3. Valent Association

Deep, excessively drained, gently sloping to hilly, sandy soils that formed in eolian sand; on stream terraces

This association consists of soils on dunes that are on stream terraces. Slopes range from 3 to 50 percent.

This association takes in about 9,000 acres, or about 1 percent of the county. It is nearly 100 percent Valent soils.

The Valent soils are on hummocks, on smooth convex dunes overlying stream terraces, and on steep and very steep irregular slopes that have a catstep surface in places. The soils have a surface layer of grayish brown fine sand and a transitional layer of light brownish gray fine sand. The underlying material, which extends to a depth of 60 inches or more, is light brownish gray sand

Nearly all of the soils in this association are in native-grass rangeland. The soils generally are not suited to farming because of the steepness of the slope, soil blowing, and droughtiness.

The use of the soils in this association as rangeland effectively controls soil blowing and water erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system that helps maintain or improve the range are concerns in management.

Ranches in this association, on the average, are about 2,000 acres in size. Most ranches have a cow-calf operation. Most calves are marketed in the fall as feeders; some are delivered to markets in adjacent counties.

Dominantly shallow and deep soils, Rock outcrop, and soils that are shallow over sand and gravel; on uplands and stream terraces

These are gently sloping to very steep, well drained to excessively drained soils. Nearly all of the acreage of these soils is native-grass rangeland. A shallow root zone restricts the use of these soils.

4. Tassel-Busher-Rock outcrop Association

Rock outcrop and shallow and deep, well drained to excessively drained, gently sloping to very steep, loamy and sandy soils that formed in material that weathered from fine-grained sandstone; on uplands

This association consists mainly of soils and rock outcrops on narrow upland ridges and breaks (fig. 2). Many areas are dissected by drainageways. Slopes range from 3 to 60 percent.

This association takes in about 179,500 acres, or about 20 percent of the county. It is about 34 percent Tassel soils, 18 percent Busher soils, 6 percent rock outcrop, and 42 percent minor soils.

The Tassel soils are gently sloping to very steep, and they are shallow. They are on narrow upland ridgetops, sharp slope breaks, and dissected side slopes of uplands. They have a surface layer of brown loamy very fine sand or very fine sandy loam 6 inches thick. The underlying material is pale brown loamy very fine sand. Weakly cemented, fine-grained sandstone bedrock is at a depth of 13 inches.

The Busher soils are gently sloping to steep, and they are deep. They are on convex ridgetops and side slopes of uplands. They have a surface layer of grayish brown loamy very fine sand or very fine sandy loam. The subsoil is pale brown loamy very fine sand. The underlying material is pale brown and very pale brown loamy very fine sand. Weakly cemented, fine-grained limy sandstone bedrock is at a depth of 57 inches.

Rock outcrop is in the steepest areas. It is on the side slopes and summit of narrow upland ridgetops and on the upper part of dissected side slopes of upland breaks. Rock outcrop is blocky or fine-grained limy sandstone; in some places it is weakly cemented limy siltstone.

The minor soils in this association are mainly the Angora, Bankard, Bridget, Dix, Epping, Jayem, and Valent soils. Angora soils are on broad to narrow convex ridgetops and on side slopes of dissected uplands. Bankard soils are on bottom lands that are dissected by stream channels. Bridget soils are on valley foot slopes. Dix soils are on dissected upland ridgetops. Epping soils are on dissected side slopes and on low narrow ridgetops. Jayem soils are on narrow ridgetops and on convex side slopes. Valent soils are on hummocks and smooth convex slopes on dunes.

The soils in this association, in most areas, are in native grasses and are used as rangeland. The soils generally are not suited to cultivated crops because of the steep slopes and the shallow root zone. Furthermore, soil blowing and water erosion are hazards. Areas of ponderosa pine are common on the steeper soils.

The use of the soils as range effectively controls soil blowing and water erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system to help maintain or improve the range are concerns in management.

Most ranches have a cow-calf operation. The calves are sold locally in the fall as feeders; some are delivered to markets in adjacent counties. The ranches, on the average, are about 2,000 acres in size; some, however, are as large as 14,000 acres.

5. Dix Association

Excessively drained, strongly sloping to very steep, sandy and loamy soils that are shallow over coarse sand and gravel; on uplands and stream terraces.

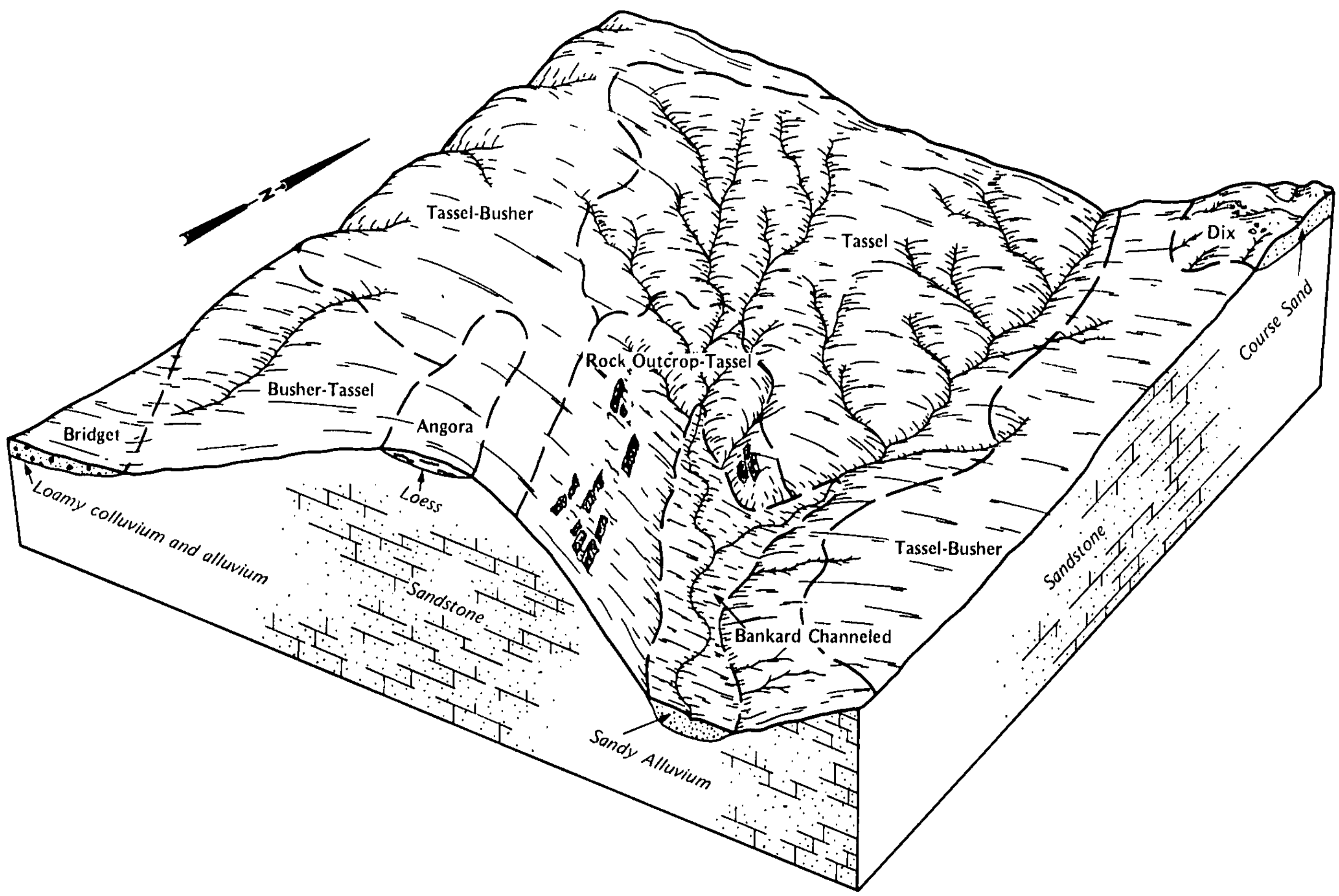


Figure 2.—Pattern of soils, topography, and underlying material in the Tassel-Busher-Rock outcrop association.

This association consists mainly of soils on dissected upland ridgetops, escarpments, and breaks of dissected stream terraces. Slopes range from 6 to 50 percent.

This association takes in about 17,900 acres, or about 2 percent of the county. It is about 50 percent Dix soils and 50 percent minor soils.

The Dix soils are on dissected upland ridgetops, breaks, and escarpments on stream terraces. They have a surface layer of brown loamy sand or sandy loam. A transitional layer is grayish brown loamy sand. The underlying material is brown very gravelly loamy coarse sand and light gray coarse sand and extends from a depth of 15 inches to a depth of 60 inches or more.

The Minor soils in this association are mainly the Alice, Bankard, Jayem, Otero, and Valent soils. Alice soils are on slopes of stream terraces. Bankard soils are on bottom lands that are dissected by stream channels. Jayem soils are on convex ridgetops and side slopes. Otero soils are on valley foot slopes and alluvial fans. Valent soils are on convex slopes on hummocks and dunes.

Nearly all of the soils in this association are in native grasses and are used as rangeland. The soils in a few areas are used as a source of sand and gravel. The soils generally are not suited to farming because of the excessive slopes, a shallow root zone, and low fertility.

The use of the soils in this association as rangeland effectively controls soil blowing and water erosion. Grazing takes place from early in spring to late in fall. Most ranches have a cow-calf operation. The calves are sold locally in the fall as feeders. Proper grazing use, timely deferment of grazing, and a planned grazing system to help maintain or improve the condition of the range are concerns in management.

Ranches in this association, on the average, are about 1,500 acres in size. Some areas within the association, however, are a part of ranches that range to 7,000 acres in size. The large ranches lie within the boundaries of two or more associations. Most of the cattle are marketed in the fall as feeder calves, although some are delivered to markets in adjacent counties.

Dominantly well drained, loamy soils on uplands, foot slopes, stream terraces, and alluvial fans

These are nearly level to moderately steep soils. Most of the acreage is cultivated. Most soils on valley foot slopes and stream terraces are used as irrigated farmland, and most soils on uplands are used for dry farming. Soil blowing and water erosion are the main hazards.

6. Duroc-Creighton-Oglala Association

Deep, well drained, nearly level to strongly sloping, loamy soils that formed in alluvial-colluvial sediment, loess, and material that weathered from fine-grained sandstone; on uplands

This association consists of soils on foot slopes, open swales, and convex ridgetops and side slopes on uplands. Slopes range from 0 to 9 percent.

This soil association takes in about 9,000 acres, or about 1 percent of the county. It is about 33 percent Duroc soils, 22 percent Creighton soils, 22 percent Oglala soils, and 23 percent minor soils.

The Duroc soils are nearly level to gently sloping. They formed in alluvial-colluvial sediment and loess on uplands. They are on narrow to broad foot slopes and in open swales. They have a surface layer of grayish brown loam, a subsurface layer of brown loam, and a subsoil of pale brown loam. The underlying material is light brownish gray, calcareous loam; it extends from a depth of 33 inches to a depth of 60 inches or more.

The Creighton soils are very gently sloping to gently sloping. They formed in loess and in material that weathered from fine-grained sandstone. They are on convex ridgetops and on side slopes of uplands. They have a surface and subsurface layer of grayish brown and brown very fine sandy loam and a subsoil of light brownish gray very fine sandy loam. The underlying material, which extends from a depth of 25 inches to a depth of 60 inches or more, is pale brown and light gray, calcareous loam.

The Oglala soils are gently sloping to strongly sloping. They formed in material that weathered from fine-grained sandstone. They are on broad convex ridgetops and on convex side slopes that are dissected by drainageways. They have a surface layer and a transitional layer of grayish brown very fine sandy loam. The underlying material, at a depth of 27 inches, is light brownish gray and light gray very fine sandy loam. Weakly cemented, fine-grained, limy sandstone is at a depth of 54 inches and extends to a depth of 60 inches or more.

The minor soils in this association are mainly the Busher, Canyon, and Jayem soils. Busher and Jayem soils are on ridgetops and side slopes. Canyon soils are on ridgetops, on sharp slope breaks, and on the upper part of side slopes.

Farms in this association are diversified; the majority of them are combination cash grain-livestock enterprises. Winter wheat and millet are the main crops. The soils are mainly dry-farmed because a sufficient supply of water for irrigation generally is not available. Some areas are in native grasses and are used as rangeland.

Soil blowing and water erosion are the main hazards if the soils are used for cultivated crops. Conservation tillage, which leaves protective amounts of crop residue on the surface, and the use of cover crops help control soil blowing and water erosion and conserve moisture. Maintaining or improving the organic matter content, tilth, and fertility is a concern in management.

Farms in this association on the average are about 1,200 acres in size. Farm produce is marketed mainly within the county or in adjacent counties.

7. Mitchell-Otero-Bridget Association

Deep, well drained, nearly level to moderately steep, loamy soils that formed in colluvial-alluvial sediment; on foot slopes and alluvial fans

This association consists mainly of soils on valley foot slopes and alluvial fans (fig. 3). Slopes range from 0 to 20 percent.

This association takes in about 89,700 acres, or about 10 percent of the county. It is about 35 percent Mitchell soils, 32 percent Otero soils, 7 percent Bridget soils, and 26 percent minor soils.

The Mitchell soils are nearly level to moderately steep. They are on valley foot slopes and alluvial fans. They have a surface layer of light brownish gray calcareous very fine sandy loam and a transitional layer of very pale brown calcareous silt loam. The underlying material is very pale brown calcareous silt loam to a depth of 60 inches or more.

The Otero soils are nearly level to moderately steep. They are on valley foot slopes and alluvial fans. They have a surface layer and a transitional layer of light brownish gray calcareous very fine sandy loam. The underlying material to a depth of 60 inches or more is very pale brown calcareous very fine sandy loam.

The Bridget soils are nearly level to moderately steep and are mainly on valley foot slopes. Some areas, however, are on convex side slopes of valleys. The soils have a surface and subsurface layer of grayish brown very fine sandy loam and a transitional layer of light brownish gray calcareous very fine sandy loam. The underlying material is pale brown calcareous very fine sandy loam and very pale brown calcareous silt loam to a depth of 60 inches or more.

The minor soils in this association are mainly the Bankard, Epping, Sarben, Valent, and Yockey soils. Bankard soils are on bottom lands that are dissected by

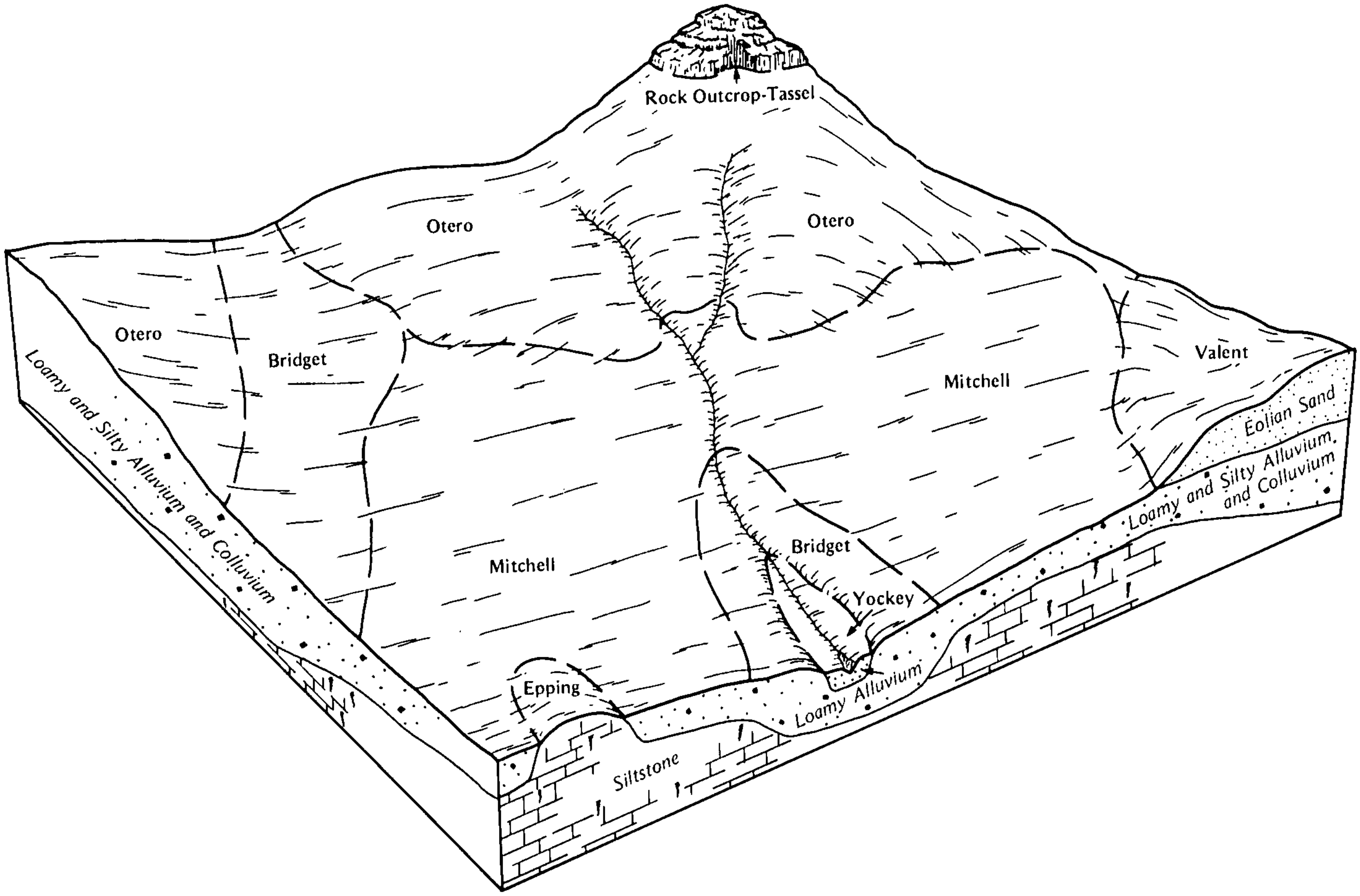


Figure 3.—Pattern of soils, topography, and underlying material in the Mitchell-Otero-Bridget association.

stream channels. Epping soils are on isolated knolls, dissected side slopes, and narrow ridgetops. Sarben soils are on stream terraces and valley side slopes. Valent soils are on hummocks and smooth convex dunes. Yockey soils are somewhat poorly drained and are on bottom lands.

The soils in this association are used mainly for diversified farming. The farms are mainly cash grain-livestock enterprises. Most farmed areas are irrigated, although some are used for dryland farming. Irrigated crops are mainly corn, sugar beets, dry edible beans, and alfalfa. Winter wheat is the principal dry-farmed crop. A few areas are planted to introduced grasses that are used as pasture or cut for hay. Where water is not available for irrigation or where the slopes are moderately steep, the areas are in native grasses and used as rangeland.

Soil blowing and water erosion are the main hazards if the soils are cultivated. Conservation tillage, which leaves protective amounts of crop residue on the surface, and the use of cover crops help control water erosion and soil blowing and conserve moisture. Maintaining or improving the organic matter content, tilth, and fertility is also a concern in management.

Farms in this association on the average are about 480 acres in size. Farm produce is marketed mainly within the county or in adjacent counties.

8. Tripp-Alice-Duroc Association

Deep, well drained, nearly level to strongly sloping, loamy soils that formed in alluvium, loess, and alluvial-colluvial material; on stream terraces

This association consists mainly of soils on stream terraces, swales, and foot slopes (fig. 4). Slopes range from 0 to 9 percent.

This association takes in about 80,800 acres, or about 9 percent of the county. It is about 30 percent Tripp soils, 23 percent Alice soils, 8 percent Duroc soils, and 39 percent minor soils.

Tripp soils are nearly level to strongly sloping and formed mainly in loamy alluvium. They have a surface layer of brown very fine sandy loam and a subsoil of brown and pale brown very fine sandy loam. The underlying material, to a depth of 60 inches, is white and light gray very fine sandy loam in the upper part and very pale brown very fine sandy loam in the lower part.

The Alice soils are nearly level to strongly sloping and formed in loamy alluvium. They have a surface layer and subsurface layer of grayish brown and brown fine sandy loam. They have a subsoil of pale brown fine sandy loam. The underlying material is very pale brown very fine sandy loam and loamy fine sand to a depth of 60 inches.

The Duroc soils are nearly level to gently sloping. They are in swales and on foot slopes of stream terraces and formed in alluvial-colluvial sediment and loess. The surface layer is grayish brown loam, the subsurface layer is brown loam, and the subsoil is pale brown loam. The underlying material, to a depth 60 inches, is light brownish gray, calcareous loam.

The minor soils in this association are mainly the Dix, Jayem, McCook, Otero, Valent, and Yockey soils. Dix soils are on side slopes of stream terraces. Jayem soils are on stream terraces. McCook soils are on high bottom lands. Otero soils are on valley foot slopes and alluvial fans. Valent soils are on hummocks and smooth convex slopes on dunes. Yockey soils are somewhat poorly drained and are on bottom lands.

Farms in this association are diversified. Most are cash grain-livestock enterprises. Most farmed areas are irrigated, although some are used for dry farming. Irrigated crops are mainly corn, sugar beets, dry edible beans, and alfalfa. Winter wheat is the principal dry-farmed crop. A few small areas are in native grasses and are used as rangeland.

Soil blowing and water erosion are the main hazards if the soils are cultivated. Conservation tillage, which

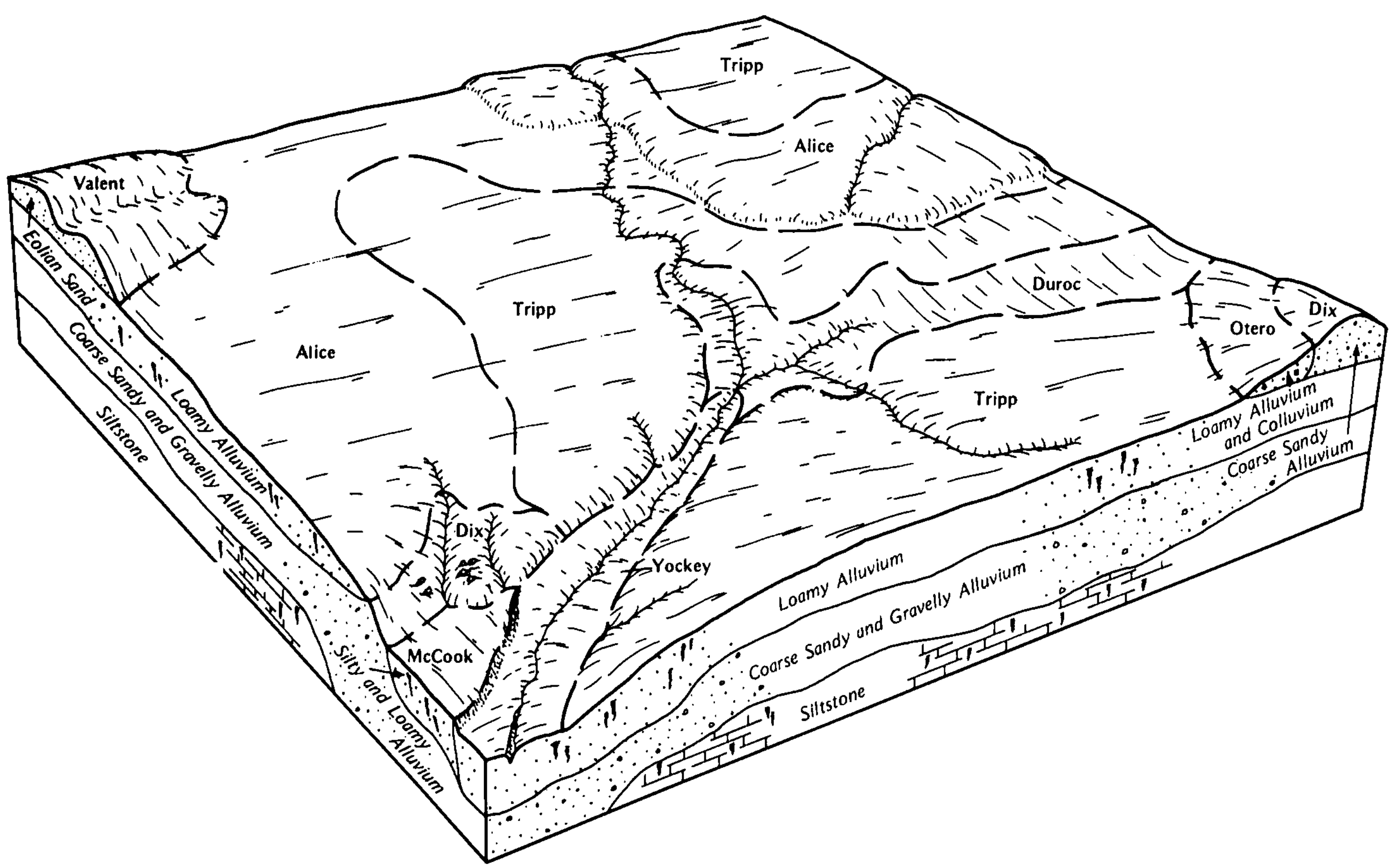


Figure 4.—Pattern of soils, topography, and underlying material in the Tripp-Alice-Duroc association.

leaves protective amounts of crop residue on the surface, and the use of cover crops help control water erosion and soil blowing and conserve moisture. Maintaining or improving the organic matter content, tilth, and fertility is also a concern in managment.

Farms in this association on the average are about 480 acres in size. Farm produce is marketed mainly within the county or in adjacent counties.

9. Keith-Duroc-Creighton Association

Deep, well drained, nearly level to strongly sloping, loamy soils that formed in loess, alluvial-colluvial sediment, and material that weathered from fine-grained sandstone; on uplands

This association consists mainly of soils on upland divides, ridgetops, swales, side slopes, and foot slopes. Slopes range from 0 to 9 percent.

This association takes in about 9,000 acres, or about 1 percent of the county. It is about 62 percent Keith soils, 13 percent Duroc soils, 11 percent Creighton soils, and 14 percent minor soils.

The Keith soils are nearly level to strongly sloping and formed in loess. They are on convex slopes on broad upland divides, ridgetops, and side slopes. They have a surface layer and subsurface layer of grayish brown loam and silt loam and a subsoil of grayish brown and light brownish gray silt loam. The underlying material is very pale brown, calcareous silt loam to a depth of 60 inches.

The Duroc soils are nearly level to gently sloping. They formed in loess and alluvial-colluvial sediment and are in swales and on broad foot slopes. The surface layer is grayish brown loam; the subsurface layer is brown loam; and the subsoil is pale brown loam. The underlying material, to a depth of 60 inches, is light brownish gray, calcareous loam.

The Creighton soils are very gently sloping and gently sloping. They formed in loess and in material that weathered from fine-grained sandstone. They are on convex ridgetops and side slopes on uplands. The surface layer and subsurface layer are grayish brown and brown very fine sandy loam; the subsoil is light brownish gray very fine sandy loam. The underlying material, to a depth of 60 inches, is pale brown and light gray, calcareous loam.

The minor soils in this association are mainly the Busher and Jayem soils. Busher soils are on upland ridgetops and side slopes. Jayem soils are on convex upland side slopes and ridgetops.

Farms on these soils are mainly the cash-grain type. Winter wheat and millet are the prinicipal crops. The soils are mainly dry-farmed because a sufficient supply of water is generally not available for irrigation.

Water erosion and soil blowing are the main hazards. Conservation tillage, which leaves protective amounts of crop residue on the surface, and the use of cover crops help control water erosion and soil blowing and help conserve moisture. Maintaining or improving the water infiltration rate, the organic matter content, tilth, and fertility is also a concern in management.

Farms in this association on the average are about 640 acres in size. Farm produce is marketed mainly within the county or in adjacent counties.

Dominantly loamy and sandy soils on uplands, stream terraces, foot slopes, and alluvial fans

These soils are nearly level to moderately steep and well drained and excessively drained. Some areas of these soils are cultivated, and some are in native grasses and are used as rangeland. These soils are used for irrigated and dryland farming. Soil blowing and water erosion are the main hazards.

10. Jayem-Valent-Busher Association

Deep, well drained and excessively drained, nearly level to moderately steep, loamy and sandy soils that formed in material that weathered from fine-grained sandstone and eolian sand; on uplands

This association consists mainly of soils on convex ridgetops, hummocks, and side slopes on uplands. It also consists of smooth areas on dunes. Intermittent drainageways are well developed. Slopes range from 0 to 20 percent.

This association takes in about 71,800 acres, or about 8 percent of the county. It is about 30 percent Jayem soils, 21 percent Valent soils, 18 percent Busher soils, and 31 percent minor soils.

The Jayem soils are nearly level to moderately steep and well drained. They formed in loamy material that weathered from fine-grained sandstone bedrock and eolian sediment. They are on convex ridgetops and side slopes on uplands. They have a surface layer of grayish brown fine sandy loam and a subsoil of brown fine sandy loam. The underlying material is light brownish gray fine sandy loam to a depth of 60 inches.

The Valent soils are nearly level to moderately steep and excessively drained. They formed in eolian sand. They are on hummocks and smooth convex slopes on upland dunes. They have a surface layer of grayish brown fine sand and a transition layer of light brownish gray fine sand. The underlying material, to a depth of 60 inches, is light brownish gray sand.

The Busher soils are very gently sloping to moderately steep and well drained. They formed in material that weathered from fine-grained sandstone bedrock. They are on convex ridgetops and side slopes of uplands. In many places, the steeper side slopes are dissected. Busher soils have a surface layer, subsurface layer, and subsoil of brown loamy very fine sand. The underlying material, which extends from a depth of 19 inches to a depth of 41 inches, is pale brown and very pale brown loamy very fine sand. Weakly cemented, limy fine-grained sandstone bedrock is at a depth of 41 inches.

The minor soils in this association are mainly the Dailey, Duroc, and Vetal soils. Dailey soils are on concave slopes of hummocks. Duroc soils are on narrow and broad foot slopes. Vetal soils are in closed swales and on alluvial fans.

Farms in this association are diversified. Most are cash grain-livestock enterprises. The soils are mainly dry-farmed. Winter wheat and millet are the principal crops. Some areas are irrigated, mainly by the sprinkler method, and corn, sugar beets, dry edible beans, and alfalfa are grown. Some areas in native grasses are used as rangeland.

Soil blowing and water erosion are the main hazards if the soils are cultivated. Conservation tillage, which leaves protective amounts of crop residue on the surface, and the use of cover crops help control soil blowing and water erosion and conserve moisture. Maintaining or improving the organic matter content, tilth, and fertility is also a concern in management.

Farms in this association on the average are about 1,300 acres, although some farms range to 5,800 acres in size. Farm produce is marketed mainly within the county or in adjacent counties.

11. Valent-Sarben-Otero Association

Deep, excessively drained and well drained, nearly level to moderately steep, sandy and loamy soils that formed in eolian sand, in material that weathered from fine-grained sandstone, and in colluvial-alluvial sediment; on foot slopes, side slopes, alluvial fans, and stream terraces

This association consists mainly of soils on hummocks and dunes on stream terraces (fig. 5). It includes soils on valley side slopes and foot slopes and on alluvial fans. Slopes range from 0 to 20 percent.

This association takes in about 116,700 acres, or about 13 percent of the county. It is about 40 percent

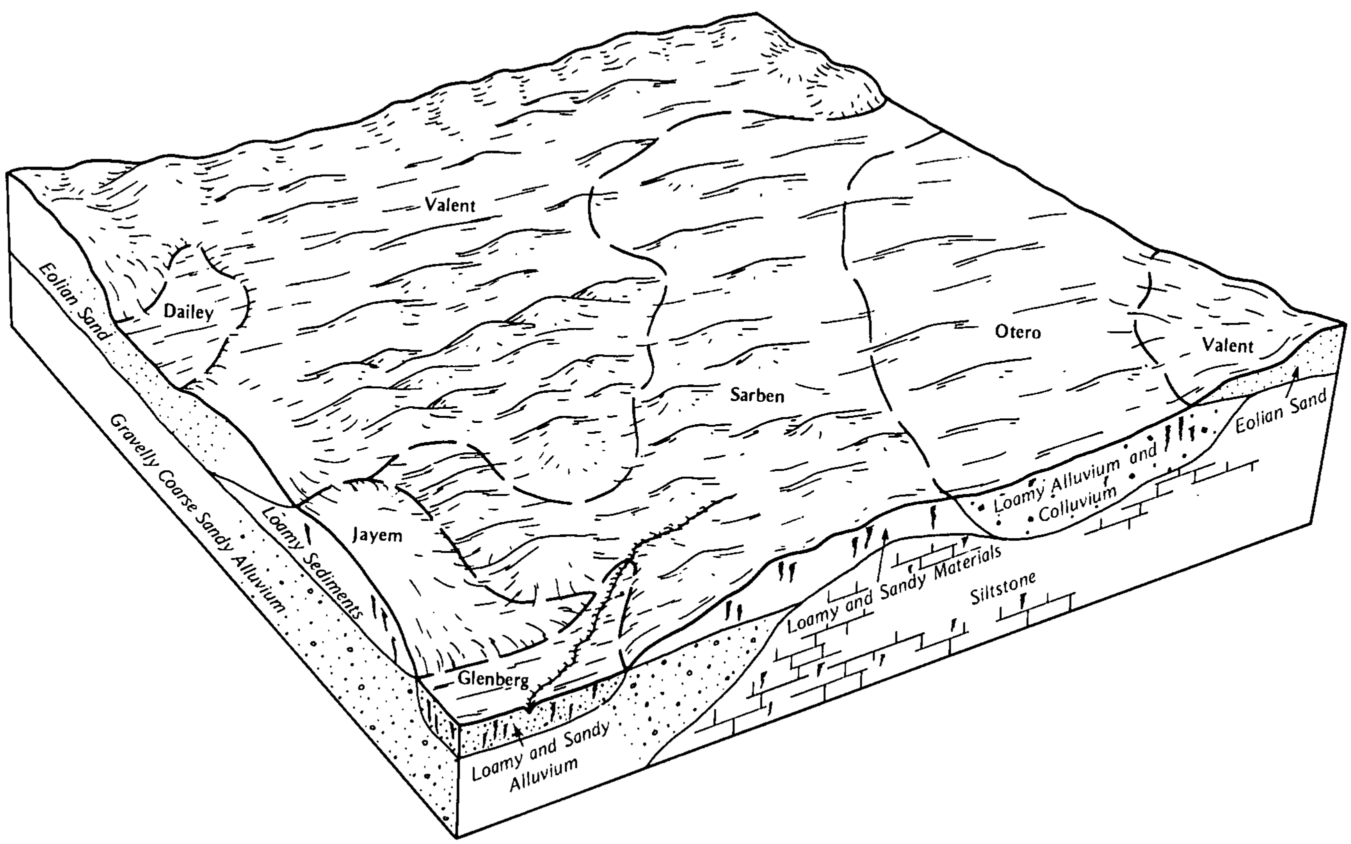


Figure 5.—Pattern of soils, topography, and underlying material in the Valent-Sarben-Otero association.

Valent soils, 11 percent Sarben soils, and 11 percent Otero soils. Soils of minor extent make up 38 percent of the association.

The Valent soils are excessively drained. They are on hummocks and smooth convex slopes on dunes that are mainly on stream terraces. Valent soils formed in eolian sand. They have a surface layer of grayish brown fine sand and a transitional layer of light brownish gray fine sand. The underlying material, which extends from a depth of 11 inches to a depth of 60 inches or more, is light brownish gray sand.

The Sarben soils are well drained. They are on stream terraces, on valley side slopes, and on hummocks. The Sarben soils have a surface layer of brown very fine sandy loam, and they have a transitional layer of pale brown loamy very fine sand. The underlying material, which extends from a depth of 22 inches to a depth of 60 inches or more, is light brownish gray loamy very fine sand.

The Otero soils are well drained. They are on valley foot slopes and alluvial fans. They formed in loamy colluvial-alluvial sediment. They have a surface layer and a transitional layer of light brownish gray, calcareous very fine sandy loam. The underlying material, which extends from a depth of 15 inches to a depth of 60 inches or more, is very pale brown, calcareous very fine sandy loam.

The minor soils in this association are mainly the Alice, Craft, Dailey, Glenberg, and Jayem series. Alice and Jayem soils are on shoulders and convex side slopes of stream terraces. Craft and Glenberg soils are on bottom lands. Dailey soils are on the concave slopes of hummocks on stream terraces.

Farms in this association are diversified. Most are cash grain-livestock enterprises. Most areas are in native grasses and are used as rangeland. On most farms, the soils are irrigated. In some areas, the soils are used for dry farming. Irrigated crops are mainly corn, sugar beets, dry edible beans, and alfalfa. Winter wheat is the principal dry-farmed crop.

Soil blowing and water erosion are the main hazards. The use of these soils as rangeland effectively controls soil blowing and water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Conservation tillage, which leaves protective amounts of crop residue on the surface, and the use of cover crops help control water erosion and soil blowing and help conserve moisture. Maintaining or improving the organic matter content is a concern in farm management. Maintaining or improving tilth and fertility is also a concern.

Farms in this association on the average are about 1,300 acres in size. Farm produce is marketed mainly within the county or in adjacent counties.

Dominantly silty, loamy, and sandy soils on bottom lands

These soils are nearly level. They are used mainly for irrigated farming. Soil blowing, flooding, and water erosion are the main hazards.

12. Yockey-Glenberg-Bankard Association

Deep, somewhat poorly drained, well drained, and somewhat excessively drained, nearly level, silty, loamy, and sandy soils that formed in alluvium; on bottom lands

This association consists mainly of soils on bottom lands of the North Platte River and Pumpkin Creek valleys (fig. 6). Slopes range from 0 to 2 percent.

This association takes in about 17,900 acres, or about 2 percent of the county. It is about 32 percent Yockey soils, 18 percent Glenberg soils, 18 percent Bankard soils, and 32 percent minor soils.

The Yockey soils are somewhat poorly drained and are on bottom lands. In a few areas they are dissected by stream channels. They have a surface layer of light brownish gray silt loam and a transitional layer of light brownish gray loam. The underlying material, to a depth of 60 inches, is stratified light brownish gray and light gray very fine sandy loam and silt loam.

The Glenberg soils are well drained and are on bottom lands. They have a surface layer of light brownish gray very fine sandy loam. The underlying material, to a depth of 60 inches, is stratified light brownish gray and light gray very fine sandy loam, loamy fine sand, loamy sand, fine sandy loam, and fine sand.

The Bankard soils are somewhat excessively drained and are on bottom lands and in some places on alluvial fans. They have a surface layer of light brownish gray loamy fine sand and a transitional layer of light brownish gray very fine sandy loam. The underlying material, to a depth of 60 inches, is stratified light gray and very pale brown loamy sand, loamy very fine sand, loamy fine sand, fine sand, and sand.

The minor soils in this association are mainly the Craft, Janise, and McCook soils. Craft soils are well drained and are on bottom lands. Janise soils are somewhat poorly drained and are on broad bottom lands. McCook soils are well drained and are on high bottom lands.

The soils in this association are used mainly for diversified farming. The farms are mainly combination cash grain-livestock enterprises. Most cultivated areas are irrigated either by the gravity method or by sprinklers. Corn, sugar beets, dry edible beans, and alfalfa are the main crops. Some areas are dry-farmed. Winter wheat is the main crop. A few areas are in native grasses and are used as rangeland. A few areas are planted to grasses that are used as pasture or cut for hay.

Soil blowing is the main hazard if the soils are cultivated. Flooding is also a hazard. Conservation tillage, which leaves protective amounts of crop residue on the surface, and use of cover crops help control soil

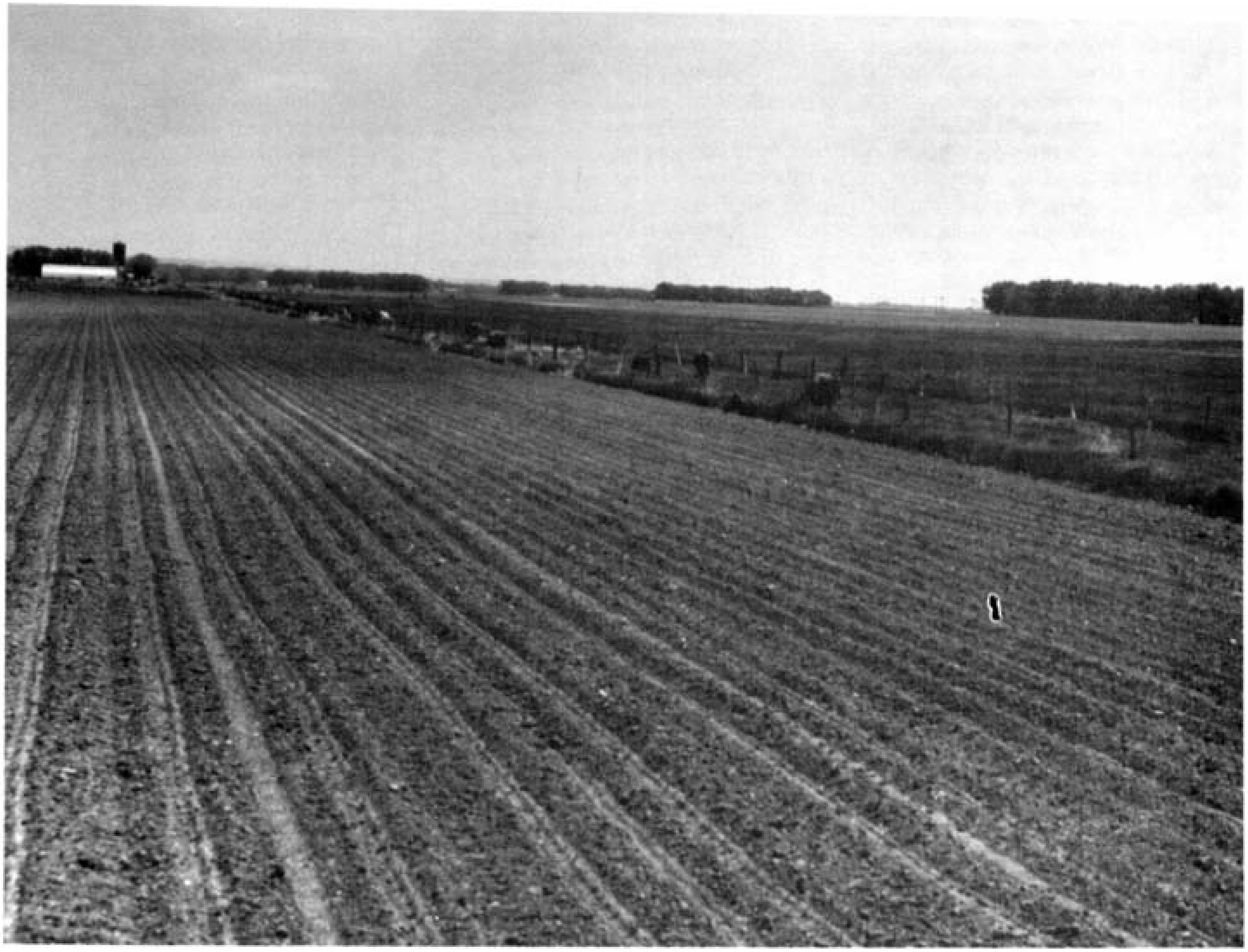


Figure 6.—The soils in the Yockey-Glenberg-Bankard association are used mainly for cultivated crops and pasture.

blowing and conserve moisture. Improving or maintaining the organic matter content, tilth, and fertility and good management of water for irrigation are concerns. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

Farms in this association on the average are about 800 acres in size. Farm produce is marketed mainly within the county or in adjacent counties.

Dominantly loamy, saline-alkali soils on bottom lands

These are nearly level, somewhat poorly drained soils that are subject to flooding. Nearly all the acreage of these soils is in native grasses and is used as rangeland or hayland. The saline-alkali characteristics of the soils restrict them to plants that are tolerant of excess salts and strongly alkaline and very strongly alkaline conditions.

13. Janise-Lisco-Gering Association

Somewhat poorly drained, nearly level, loamy soils that are deep or moderately deep over coarse sand and gravel and that formed in calcareous alluvium; on bottom lands

This association consists mainly of areas on bottom lands of the North Platte River and Pumpkin Creek valleys. Slopes range from 0 to 2 percent.

This association takes in about 26,900 acres, or about 3 percent of the county. It is about 33 percent Janise soils, 17 percent Lisco soils, 14 percent Gering soils, and 36 percent minor soils.

The Janise soils are deep and are on broad bottom lands. The soils have a surface layer of light grayish brown loam and a subsurface layer of light gray loam. These layers are strongly alkaline. The subsoil is light brownish gray and light gray loam. It is very strongly alkaline. The underlying material also is very strongly alkaline. It is white loam and pale brown loamy fine sand from a depth of about 24 inches to a depth of 40 inches. Below that, it is very pale brown and brown coarse sand.

The Lisco soils are deep and are on bottom lands. They have a surface layer of grayish brown very fine sandy loam and a subsurface layer of light brownish gray very fine sandy loam. The subsoil is light brownish gray very fine sandy loam and fine sandy loam. It is very strongly alkaline. The underlying material, to a depth of 60 inches, is light gray fine sandy loam in the upper part and very pale brown loamy fine sand in the lower part. It is very strongly alkaline in the upper part and strongly alkaline in the lower part.

The Gering soils are moderately deep over gravelly coarse sand and are on bottom lands. They have a surface layer of grayish brown loam and a subsurface layer of light brownish gray loam. These layers are strongly alkaline. The underlying material, to a depth of 24 inches, is light brownish gray loam. It is very strongly alkaline. The layer below that is very pale brown coarse sand and gravelly coarse sand to a depth of about 60 inches.

The minor soils in this association are mainly the Barney, Craft, Minatare, and Yockey soils. All of these soils are on bottom lands. The Barney soils are poorly drained, and the Craft soils are well drained. The Minatare and Yockey soils are somewhat poorly drained.

Nearly all area's of the soils in this association are in native grasses and are used as rangeland or hayland. A few areas are planted to introduced grasses that are used as pasture or cut for hay. The soils are generally not suited to farming because they are affected by saline-alkaline characteristics.

Most ranches in this association are the cow-calf operation type. The calves are sold as feeders in the fall; some are delivered to markets in adjacent counties. Grazing takes place from late in spring to early in fall. Native hay is the major feed supply for livestock during winter.

The use of the soils in this association as rangeland and hayland effectively controls soil blowing. Proper grazing use, proper mowing height, timely deferment of grazing or haying, and a planned grazing system are concerns in management.

Ranches in this association on the average are about 1,000 acres. Some, however, are as large as 13,000 acres in size.

Dominantly somewhat poorly drained and poorly drained soils that are shallow over sand and gravel; on bottom lands

These soils are nearly level. Nearly all the acreage of these soils is in native grasses and is used primarily as hayland. Flooding is the main hazard.

14. Gothenburg-Barney-Platte Association

Somewhat poorly drained and poorly drained, nearly level, sandy and loamy soils that are shallow over sand and gravel and that formed in alluvium; on bottom lands

This association consists mainly of soils on bottom lands along the North Platte River channels (fig. 7). The soils are subject to flooding. Slopes range from 0 to 2 percent.

This association takes in about 17,900 acres, or about 2 percent of the county. It is about 37 percent Gothenburg soils, 36 percent Barney soils, 9 percent Platte soils, and 18 percent minor soils.

The Gothenburg soils are shallow and very shallow to gravelly coarse sand. They are somewhat poorly drained. They are on bottom lands that commonly are dissected by old, shallow, abandoned stream channels. They have a surface layer of grayish brown, calcareous loamy sand. The underlying material, to a depth of 20 inches, is stratified light gray and light brownish gray, calcareous fine sand, coarse sand, and loamy fine sand. Light gray gravelly coarse sand extends from a depth of 20 inches to a depth of 60 inches or more.

The Barney soils are poorly drained. They are lower on the bottom lands than Gothenburg soils and commonly are dissected by old, shallow, abandoned stream channels. They have a surface layer of grayish brown loam. The underlying material, which extends from a depth of 7 inches to 60 inches or more, is white gravelly sand and gravelly coarse sand.

The Platte soils are somewhat poorly drained. They are higher on the bottom lands than Gothenburg soils. They have a surface layer of dark grayish brown loam. The underlying material, to a depth of 16 inches, is stratified grayish brown and light brownish gray fine sandy loam and very fine sandy loam. Light gray, stratified gravelly coarse sand extends from a depth of 16 inches to a depth of 60 inches or more.

The minor soils in this association are mainly the Gering, Glenberg, Janise, Lisco, and Yockey series. Gering, Janise, Lisco, and Yockey soils are somewhat poorly drained, and Glenberg soils are well drained. All of these soils are on bottom lands.

Nearly all of this association is in native grasses and is used primarily as hayland, although some areas are grazed. If trees, shrubs, and brush invade an area, its use as rangeland is restricted. The soils in this association are generally not suited to use as farmland because of the shallow root zone, wetness from a high water table, and flooding.

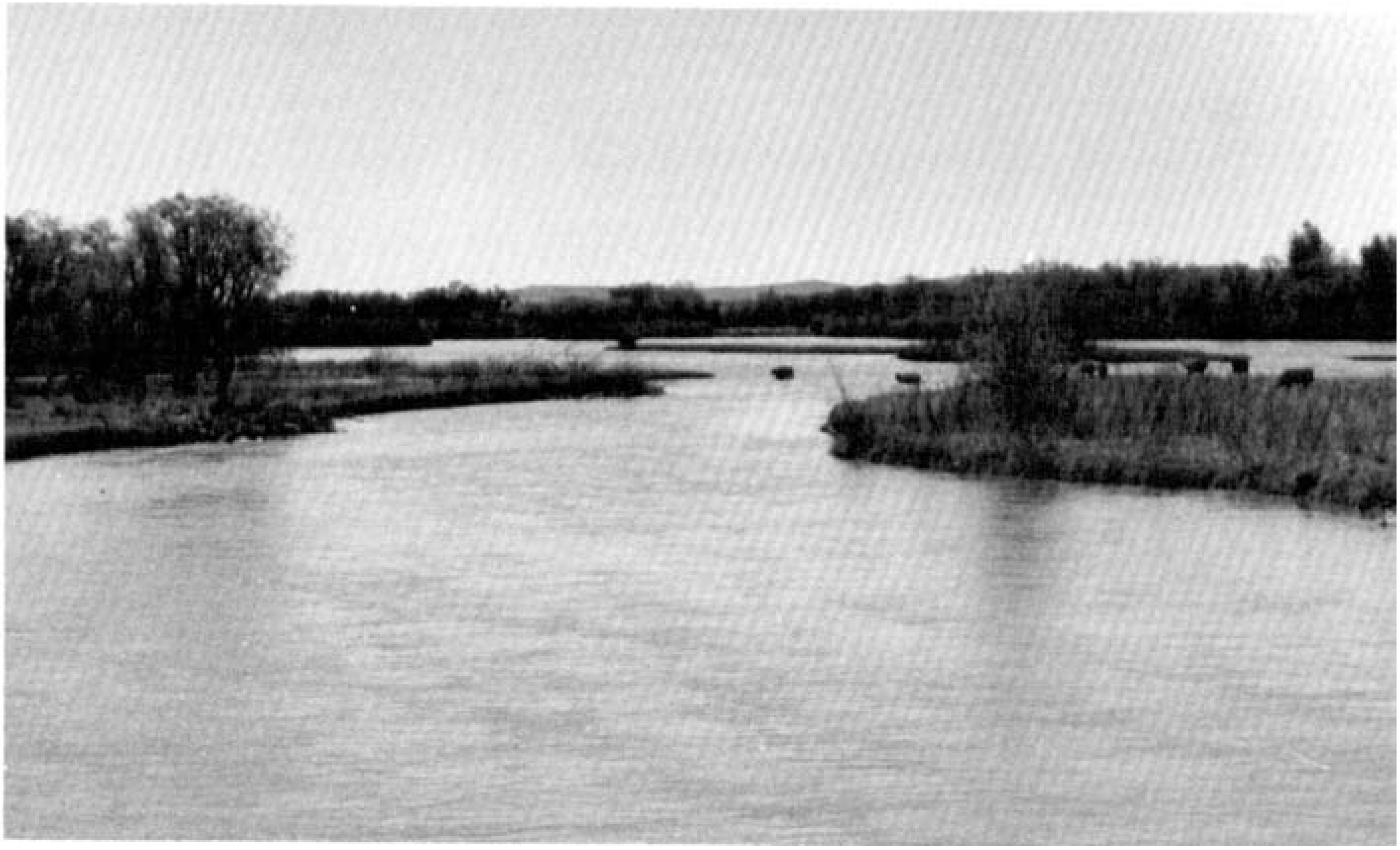


Figure 7.—An area of the Gothenburg-Barney-Platte association, through which the North Platte River runs. The soils are used mainly for pasture.

The use of soils in this association as hayland and as rangeland effectively controls soil blowing. Haying at a proper time, mowing to a proper height, deferring grazing in a timely manner, and restricting use during very wet periods help maintain or improve the native plants. The native hay that is harvested is fed to livestock during the winter. The livestock graze from late in spring to early in fall.

Most areas of this association are a part of ranches that range up to 13,000 acres in size.

Detailed Soil Map Units

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

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

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

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the 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, Tripp very fine sandy loam, 1 to 3 percent slopes, is one of several phases in the Tripp 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 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. Alice-Dix complex, 6 to 20 percent slopes, is an example.

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

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

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.

Some of the boundaries on the soils maps of Morrill County do not match those on the soil maps of adjacent counties, and some of the soil names and descriptions do not fully agree. The differences are a result of improvements in the classification of soils, particularly modification or refinements in soil series concepts. Also, there may be differences in the intensity of mapping or in the extent of the soils within the survey area.

Soil Descriptions

AaB—Alice loamy fine sand, 0 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in alluvium and, in places, in thin deposits of sandy and loamy eolian material. It is on stream terraces. The areas range from 5 to 80 acres in size.

Typically, the surface layer is pale brown, very friable loamy fine sand 7 inches thick. The subsurface layer is brown, very friable very fine sandy loam about 9 inches thick. The subsoil is brown and pale brown, very friable very fine sandy loam about 22 inches thick. The underlying material is pale brown, calcareous very fine sandy loam to a depth of more than 60 inches. In some places the surface layer is calcareous. Soil blowing or winnowing has removed many of the finer soil particles, including silt-sized particles, from the surface layer.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate. The content of organic matter is low. The water intake rate for irrigation is high. Tilth is fair.

Most of the acreage of this soil is farmed, and most areas are irrigated. A few small areas are in native grasses and are used as rangeland or pasture.

The soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, help control soil blowing and water erosion, and conserve moisture. Cover crops also help. Stripcropping helps reduce soil blowing. Returning crop residue to the soil helps improve tilth, the organic matter content, and fertility.

If irrigated, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. It is best suited to irrigation by the sprinkler method. Soil blowing is a severe hazard. The use of a winter cover crop helps reduce the harzard. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, help control soil blowing, and help conserve moisture. Crop residue on the soil helps improve tilth and fertility and increases the content of organic matter.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Proper stocking rates, applying fertilizer in amounts based on soil tests, rotating pasture, and deferring grazing in a timely manner help maintain or improve the pasture.

This soil is suited to use as rangeland. This use effectively controls soil blowing. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Soil blowing can cause severe damage if the protective cover is lost. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Because of the soil blowing hazard, range seeding may be needed where the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well or can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and careful application of selected, appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows of trees. Irrigation, by the drip system, can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of temporary shallow excavations can be shored to prevent sloughing or caving. Good surface drainage reduces damage to roads and streets caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IVe-5 dryland and IIIe-10 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

AcB—Alice fine sandy loam, 0 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in alluvium and in thin deposits of loamy eolian material on stream terraces. The areas of this soil range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 8 inches thick. The subsurface layer is brown, very friable fine sandy loam about 7 inches thick, and the subsoil is pale brown, very friable fine sandy loam about 14 inches thick. The underlying material is very pale brown. The upper part, where lime has accumulated, is very fine sandy loam. The lower part is loamy fine sand to a depth of more than 60 inches. In some places the dark upper layers are more than 20 inches thick and are slightly acid. Also, in places the layer of accumulated lime is not always present and depth to calcareous material is about 60 inches.

Included with this soil in mapping are small areas of soils that have a loam surface layer and subsoil. The included soils make up about 5 to 10 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is high. The water intake rate for irrigation is moderately high. The content of organic matter is moderate, and tilth is good.

Nearly all of the acreage of this soil is farmed. Many areas are irrigated; however, some are dry-farmed. A few areas are used as pasture.

This soil is suited to dry-farmed winter wheat. Soil blowing is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping reduces soil blowing. Returning crop residue to the soil improves the organic matter content and fertility and helps maintain tilth.

If irrigated, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Efficient management of water for irrigation is a concern because of the slope. Land leveling increases the efficiency of gravity irrigation systems. The sprinkler method also can be used to increase the efficiency of irrigation. Soil blowing is a hazard. The use of a winter cover crop helps reduce the hazard. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Using a green manure crop and returning crop residue to the soil are good ways to improve tilth, the infiltration of water, the organic matter content, and fertility, especially if the soil has been disturbed by land-leveling.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Efficient management of irrigation water and use of fertilizer in amounts based on soil tests help maintain plant vigor and forage production. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well or can grow well in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and careful application of selected, appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows of trees. Supplemental water, for example, from irrigation by the drip system, may be needed during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of temporary shallow excavations can be shored to prevent sloughing or caving. Good surface drainage reduces damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIe-3 dryland and IIe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

AcC—Alice fine sandy loam, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed in alluvium and, in places, in thin deposits of loamy eolian material. It is on convex slopes of stream terraces. The areas of this soil range from 5 to 80 acres in size.

Typically, the surface layer is brown, very friable fine sandy loam about 9 inches thick. The subsoil is very friable very fine sandy loam about 14 inches thick. It is brown in the upper part, and pale brown and calcareous in the lower part. The underlying material, to a depth of more than 60 inches, is very pale brown, calcareous very fine sandy loam. A layer of accumulated lime is in the upper part. In some places the surface layer is calcareous and lighter in color. Also, in places the dark upper layers are more than 20 inches thick and the depth to calcareous material can be 60 inches.

Included with this soil in mapping are small areas of Bridget and Dix soils. Bridget soils have less sand in the subsoil than the Alice soil, are calcareous at or near the surface, and are on foot slopes. Dix soils are shallow over very gravelly loamy coarse sand and are on breaks of stream terraces. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is high, and the water intake rate for irrigation is moderately high. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is farmed. In many areas the soil is irrigated. In some areas the soil is dry-farmed. A few small areas are in native grasses and are used as rangeland or as pasture.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface. They also help control soil blowing and water erosion and conserve moisture. Stripcropping reduces soil blowing. Returning crop residue to the soil improves the organic matter content and fertility and maintains tilth.

If sprinkler irrigation is used, this soil is suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Efficient management of irrigation is a concern because of slope. Land leveling increases the efficiency of gravity systems of irrigation. Soil blowing is a moderate hazard, which the use of a winter cover crop helps reduce. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue help improve tilth, the water infiltration rate, the content of organic matter, and fertility, especially where this soil has been disturbed by land leveling.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the grasses. Making efficient use of water for irrigation and applying fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock or haying at an improper time and mowing to an improper height reduce the protective cover and cause deterioration of the native plants; consequently, damage by soil blowing can be severe. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and application of selected, appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Trees planted on the contour help reduce erosion and excessive runoff. Irrigation by the drip system can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of temporary shallow excavations can be shored to prevent sloughing or caving. Good surface drainage can reduce damage to roads that is caused by frost action. Crowning the roads by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IVe-3 dryland and IIIe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

AcD2—Alice fine sandy loam, 6 to 9 percent slopes, eroded. This soil is deep, strongly sloping, and well drained. It formed in alluvium and in thin deposits of loamy eolian material on convex side slopes of stream terraces. The areas of this soil are elongated and range from 5 to 8 acres in size.

Typically, the surface layer is brown, very friable fine sandy loam. Erosion has thinned the surface layer to about 5 inches. In places, tillage has mixed some of the upper part of the subsoil with the remaining surface layer. The subsoil is very friable and about 29 inches thick. It is pale brown fine sandy loam in the upper part and light brownish gray loamy sand in the lower part. The underlying material is very pale brown, calcareous loamy fine sand to a depth of more than 60 inches. In some places, the surface layer is calcareous at or near the surface.

Included with this soil in mapping are small areas of Dix soils. Dix soils are shallow over very gravelly loamy coarse sand and are in positions on the landscape similar to those of the Alice soil. In places, siltstone is within a depth of 40 inches. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate, and the water intake rate for irrigation is moderately high. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is farmed. The soil is irrigated and dry-farmed. A few small areas in native grasses are used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help control soil blowing and water erosion and help conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil improves the content of organic matter and fertility and maintains tilth.

If sprinkler irrigation is used, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Efficient management of irrigation water is a concern because of excessive slope. Soil blowing and water erosion are severe hazards. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface and thus control erosion and conserve moisture. Crop residue on the soil improves the content of organic matter and fertility and maintains tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Soil blowing can cause severe damage if the protective cover is not adequate. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding to stabilize the soil is generally needed if land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and application of selected, appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows of trees. Trees planted on the contour help reduce erosion and excessive runoff. Supplemental water can be provided during periods of low rainfall. The drip system of irrigation is commonly used.

This soil is generally suited to septic tank absorption fields and dwellings without basements. Sewage lagoons need to be lined or sealed to prevent seepage. For sewage lagoons, extensive grading is required to modify the slope and shape the lagoon. The walls and sides of shallow excavations can be shored to prevent sloughing or caving. Good surface drainage can reduce damage to roads that is caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IVe-3 dryland and IVe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

AdB—Alice-Dix complex, 0 to 3 percent slopes. This complex consists of areas of Alice soil that is deep and of Dix soil that is shallow over gravelly coarse sand. The Alice soil is well drained and is in uniform, very gently sloping areas. The Dix soil is excessively drained and is in convex areas along narrow drainageways. The Alice soil formed on stream terraces in loamy alluvium. The Dix soil formed in loamy materials that were deposited over gravelly coarse sand. Areas of this unit range from 5 to 120 acres in size. The Alice soil makes up 50 to 70 percent of the areas, and the Dix soil makes up 15 to 35 percent. The areas of these soils are so intricately mixed or so small that it was not practical to map them separately.

Typically, the Alice soil has a surface layer of grayish brown, very friable fine sandy loam about 14 inches thick. The subsoil is light brownish gray, very friable fine sandy loam also about 14 inches thick. The underlying material extends to a depth of 60 inches or more. It is light brownish gray fine sandy loam in the upper part, light brownish gray loamy sand in the middle part, and pale brown, gravelly coarse sand in the lower part. In some places the surface layer is light brownish gray and calcareous. Also, in places dark colors extend to a depth of 20 inches or more.

Typically, the Dix soil has a surface layer of grayish brown, very friable sandy loam about 8 inches thick. A transitional layer is light brownish gray, very friable sandy loam about 4 inches thick. The underlying material is light brownish gray, gravelly coarse sand in the upper part and light gray coarse sand in the lower part to a depth of 60 inches or more. In some places the surface soil is light brownish gray.

Included with these soils in mapping are small areas of Dailey and Valent soils and outcrops of gravelly coarse sand. Dailey soils are sandy throughout and are in concave areas on hummocks. Valent soils are sandy throughout the solum and are on a rolling landscape. The outcrops of gravelly coarse sand are on convex side slopes. The included soils make up 5 to 20 percent of the map unit.

Permeability is moderately rapid for the Alice soil and rapid over very rapid for the Dix soil. Runoff is slow. The available water capacity of the Alice soil is moderate, and that of the Dix soil is low. The organic matter content of the Alice soil is moderate, and that of the Dix soil is moderately low. The water intake rate for irrigation is moderately high. The root zone of the Alice soil is deep, and that of the Dix soil is shallow. The Alice soil has good tilth.

Most of the acreage of these soils is farmed under irrigation, but some areas are dry-farmed. Some areas in native grasses are used as rangeland. A few small areas are used as pasture.

These soils are suited to dry-farmed winter wheat. Soil blowing is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil improves the content of organic matter and fertility and maintains tilth.

If sprinkler irrigation is used, these soils are suited to corn, sugar beets, dry edible beans, and alfalfa. Soil blowing is a moderate hazard. The use of a winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. The low available water capacity of the Dix soil is a factor in determining the rate and amount of irrigation water needed. Crop residue on the soils improves the content of organic matter and fertility and helps maintain tilth.

These soils are suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and haying at an improper time reduce the growth and vigor of the grasses. Irrigating efficiently and applying fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Reduction of the protective cover can cause severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants, and range seeding may be needed if the land use is changed from cropland to rangeland.

The Alice soil is suited to trees and shrubs in windbreaks. The Dix soil is not suited because of the shallow root zone. Onsite investigation is needed before planning a windbreak on these soils. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by timely application of selected, appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

Onsite investigation is needed for all engineering construction on the soils in this complex. The Alice soil is generally suited to septic tank absorption fields. The Dix soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of the underground water table. An alternate site, therefore, should be considered. Sewage lagoons need to be lined or sealed to prevent seepage. These soils are generally suited to dwellings. The walls or sides of temporary shallow excavations can be shored to prevent sloughing or caving. On the Alice soil, good surface drainage can reduce damage to roads that is caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage. The Dix soil is generally suited to roads.

These soils are assigned to capability units IIIe-3 dryland and IIIe-8 irrigated. The Alice soil is in the Sandy range site, and the Dix soil is in the Shallow to Gravel range site. The Alice soil is in windbreak suitability group 5, and the Dix soil is in windbreak suitability group 10.

AdC—Alice-Dix complex, 3 to 6 percent slopes. This complex consists of Alice soil that is deep and of Dix soil that is shallow over very gravelly loamy coarse sand. The Alice soil is well-drained and is on gently sloping, convex slopes and on foot slopes of stream terraces. The Dix soil is excessively drained and is on convex side slopes of stream terraces. The Alice soil formed in loamy alluvium and, in places, in thin deposits of loamy eolian material. The Dix soil formed in loamy and sandy material that was deposited over very gravelly loamy coarse sand. The areas of this complex range from 5 to 75 acres in size. The Alice soil makes up 40 to 60 percent of the areas, and the Dix soil makes up 30 to 50 percent. The areas of these soils are so intricately mixed or so small that it was not practical to map them separately.

Typically, the Alice soil has a surface layer of grayish brown, very friable fine sandy loam about 14 inches thick. The subsoil is light brownish gray, very friable fine sandy loam about 7 inches thick. The underlying material extends to a depth of 60 inches or more. It is pale brown, calcareous fine sandy loam in the upper part and light brownish gray, calcareous sandy loam in the lower part. In some places the surface layer is lighter in color than is typical, and it is calcareous. Also, in places the subsoil is loamy fine sand.

Typically, the Dix soil has a surface layer of brown, very friable loamy sand about 6 inches thick. A transitional layer is grayish brown, very friable loamy sand about 9 inches thick. The underlying material is brown, very gravelly loamy coarse sand in the upper part and light gray coarse sand in the lower part, to a depth of 60 inches or more.

Included with these soils in mapping are small areas of Valent and Vetal soils and outcrops of very gravelly loamy coarse sand. The Valent soils are sandy throughout and are on convex ridgetops. The Vetal soils have a surface layer that is more than 20 inches thick. They are on concave slopes in open swales. The outcrops of very gravelly loamy coarse sand are on convex dissected side slopes. The included soils make up 5 to 20 percent of the complex.

The permeability of the Alice soil is moderately rapid, and that of the Dix soil is rapid over very rapid. Runoff is slow. The available water capacity of the Alice soil is moderate, and that of the Dix soil is low. The organic matter content of the Alice soil is moderate, and that of the Dix soil is moderately low. The water intake rate for irrigation is moderately high. The root zone of the Alice soil is deep, and that of the Dix soil is shallow. Tilth is good.

Much of the acreage of these soils is in native grasses and is used as rangeland. Some areas, however, are farmed and are used for irrigated as well as dry-farmed crops.

The soils are poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil improves the content of organic matter and fertility and maintains tilth.

These soils are suited to corn, sugar beets, dry edible beans, and alfalfa if sprinkler irrigation is used. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. The low available water capacity of the Dix soil is a factor in determining the rate and amount of irrigation water needed. Returning crop residue to the soil improves the content of organic matter and fertility and maintains tilth.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. If the protective cover is lost, soil blowing can cause severe damage. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Brush managment may be needed to control undesirable woody plants. Range seeding to stabilize the soil may be needed if land use is changed from cropland to rangeland.

The Alice soil is suited to trees and shrubs in windbreaks, but the Dix soil is not suited because of a shallow root zone. Onsite investigation is needed before planning a windbreak on these soils. Species should be selected that can tolerate drought. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by timely application of selected, appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

Onsite investigation is needed for all engineering construction on the soils in this complex. The Alice soil is generally suited to septic tank absorption fields. The Dix soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of the underground water table. Therefore, a suitable alternate site should be considered. Sewage lagoons on these soils need to be lined or sealed to prevent seepage. These soils are generally suited to dwellings. The walls or sides of temporary shallow excavations need to be shored to prevent sloughing or caving. On the Alice soil, good surface drainage can reduce damage to roads that is caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage. The Dix soil is generally suited to roads and streets.

These soils are assigned to capability units IVe-3 dryland and IVe-8 irrigated. Alice soil is in the Sandy range site, and the Dix soil is in Shallow to Gravel range site. Alice soil is in windbreak suitability group 5, and Dix soil is in windbreak suitability group 10.

AdE—Alice-Dix complex, 6 to 20 percent slopes. This complex consists of Alice and Dix soils.

The Alice soil is deep and well drained. It formed in loamy alluvium and in places in thin deposits of loamy eolian material. It is on the lower part of convex side slopes of stream terraces.

The Dix soil is shallow over gravelly coarse sand; it is excessively drained. The soil formed in loamy and sandy material deposited over gravelly coarse sand. It is on convex side slopes and on ridgetops of stream terrace breaks.

The areas of this complex range from 5 to 120 acres in size. The Alice soil makes up 30 to 65 percent of the areas, and the Dix soil makes up 10 to 45 percent. The areas of these soils are so intricately mixed or so small that it was not practical to separate them in mapping.

Typically, the Alice soil has a grayish brown, very friable fine sandy loam surface layer about 8 inches thick. The subsurface layer is grayish brown, very friable fine sandy loam about 5 inches thick. The subsoil is pale brown, very friable very fine sandy loam about 5 inches thick. The underlying material is very pale brown and calcareous and extends to a depth of more than 60 inches. It is very fine sandy loam in the upper part, a layer where lime has accumulated. It is fine sandy loam in the middle part and loamy fine sand in the lower part. In some places the depth to calcareous material is more than 40 inches. Also, in places the surface layer is lighter in color and is calcareous.

Typically, the Dix soil has a surface layer of grayish brown, very friable sandy loam about 6 inches thick. A transitional layer is grayish brown, very friable gravelly sandy loam about 7 inches thick. The underlying material is pale brown, calcareous gravelly coarse sand in the upper part and very pale brown, calcareous coarse sand in the lower part. In some places the surface layer is lighter in color.

Included with these soils in mapping are small areas of Valent soils and outcrops of gravelly coarse sand and of siltstone bedrock. Valent soils are sandy throughout and are on dunes. The outcrops of gravelly coarse sand are on convex slope breaks, side slopes, and ridgetops. The outcrops of siltstone bedrock are on sharp slope breaks. The included areas make up about 20 to 25 percent of the complex.

Permeability of the Alice soil is moderately rapid, and that of the Dix soil is rapid over very rapid. Runoff is medium on the Alice soil and rapid on the Dix soil. The available water capacity of the Alice soil is moderate, and that of the Dix soil is low. The organic matter content of the Alice soil is moderate, and that of the Dix soil is moderately low. The root zone is deep in the Alice soil and shallow in the Dix soil.

Nearly all of the acreage of these soils is in native grasses and is used as rangeland.

The soils are not suited to farming because of the moderately steep slope, soil blowing, and droughtiness. These hazards and limitations are difficult or impractical to overcome.

The soils are suited to use as rangeland, and this use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It also causes severe losses by soil blowing and water erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

The Alice soil is poorly suited to trees and shrubs in windbreaks. The Dix soil is not suited because of the shallow root zone. Onsite investigation is needed before planning a windbreak on these soils. For the Alice soil, species should be selected that can tolerate drought moderately well or can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed. This can be accomplished by good site preparation and by using appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Trees can be planted on the contour to help reduce excessive runoff. Supplemental water, for example, from irrigation by the drip system, may be needed during periods of low rainfall.

Onsite investigation is needed for all engineering construction on the soils in this complex. If a septic tank absorption system is to be installed on the Alice soil, land shaping generally is necessary and the field should be laid out on the contour. The Dix soil can readily absorb the effluent from septic tank absorption fields, but it cannot adequately filter the effluent. The poor filtering capacity can result in pollution of the underground water. The soils are not suited to sewage lagoons because of seepage and slope. Alternate sites on other soils that are suited should be considered. Dwellings need to be properly designed to accommodate the slope, or the soils can be graded to an acceptable gradient. The walls or sides of temporary shallow excavations can be shored to prevent sloughing or caving. Cuts and fills generally are needed to provide a suitable grade for roads. On the Alice soil, damage to roads by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The soils are assigned to capability unit VIe-3 dryland. The Alice soil is in the Sandy range site, and the Dix soil is in the Shallow to Gravel range site. The Alice soil is in windbreak suitability group 5, and the Dix soil is in windbreak suitability group 10.

AhD—Altvan-Dix complex, 3 to 9 percent slopes. This complex consists of gently sloping and strongly sloping soils on uplands and stream terraces. The Altvan soil is well drained and moderately deep over sand and gravel. It formed in loamy sediments overlying gravel and sand on convex ridgetops and on side slopes of uplands and breaks of stream terraces. The Dix soils is excessively drained and is shallow over sand and gravel on upland ridgetops. The areas of this complex range from 10 to 90 acres in size and are 50 to 70 percent Altvan soil and 20 to 40 percent Dix soil.

Typically, the Altvan soil has a surface layer of grayish brown, very friable loam about 10 inches thick. The subsoil is very friable and about 15 inches thick. It is brown fine sandy loam in the upper part, pale brown sandy clay loam in the middle part, and very pale brown loam in the lower part where lime has accumulated. The underlying material is very gravelly coarse sand to a depth of 60 inches or more. It is pale brown and very pale brown in the upper part, where lime has accumulated, and very pale brown in the lower part. In some places the depth to very gravelly coarse sand is 40 inches or more.

Typically, the Dix soil has a surface layer of dark grayish brown, friable sandy loam about 5 inches thick. A transitional layer is grayish brown sandy loam about 13 inches thick. The lower part is calcareous. The underlying material is yellowish brown, very gravelly coarse sand to a depth of 60 inches or more. In some places the surface layer is lighter in color than is typical and is less than 10 inches thick.

Included with these soils in mapping are small areas of Keith and Busher soils and outcrops of gravel. Keith soils are deep and are on broad ridgetops. Busher soils are deep and are on the lower part of side slopes. Outcrops of gravel are on steep breaks and narrow ridgetops. In some areas weakly cemented siltstone bedrock is at a depth of 40 to 60 inches. The included areas make up 10 to 20 percent of the complex.

Permeability of the Altvan soil is moderate over very rapid. Permeability of the Dix soil is rapid over very rapid. Runoff is medium. The available water capacity is low. The organic matter content of the Altvan soil is moderate, and that of the Dix soil is moderately low. The water intake rate for irrigation is moderate. The root zone of the Altvan soil is moderately deep, and that of the Dix soil is shallow. Tilth is good.

Most of the acreage of these soils is in native grasses and is used as rangeland. A few small areas are farmed. Some areas are irrigated.

These soils are poorly suited to dry-farmed crops, including winter wheat and millet. Water erosion is a severe hazard where the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soils maintains tilth, improves fertility, and increases the content of organic matter.

If sprinkler irrigation is used, the soils are poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Water erosion is a severe hazard. Winter cover crops help reduce water erosion. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control erosion, and conserve moisture. The low available water capacity of the Dix soil is a factor in determining the rate and amount of irrigation water needed. Crop residue on the soils maintains tilth, improves fertility, and increases the content of organic matter.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of native plants. Overgrazing also contributes to severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding may be needed if the land use is changed from cropland to rangeland.

The Altvan soil is suited to trees and shrubs in windbreaks, but the Dix soil is not suited because of a shallow root zone. Onsite investigation is needed before planning a windbreak on these soils. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by timely cultivation between the rows with conventional equipment. Using appropriate herbicides or hoeing by hand can control weeds in the rows. Planting on the contour helps reduce excessive runoff and erosion. Irrigation by the drip system is commonly used to supply water during periods of low rainfall.

Onsite investigation is needed for all engineering construction on the soils in this complex. The soils readily absorb the effluent from septic tank absorption fields, but do not adequately filter the effluent. The poor filtering capacity can result in the pollution of ground water. A suitable alternate site should be considered. Sewage lagoons need to be lined or sealed to prevent seepage. The soils are generally suited to dwellings. The walls or sides of shallow excavations can be shored temporarily to prevent sloughing or caving. Good surface drainage on the Altvan soil can reduce damage to roads that is caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage. The Dix soil is generally suited to local roads.

These soils are assigned to capability units IVe-1 dryland and IVe-7 irrigated. The Altvan soil is in the Silty range site, and the Dix soil is in the Shallow to Gravel range site. Altvan soil is in windbreak suitability group 6G, and Dix soil is in windbreak suitability group 10.

AnC—Angora very fine sandy loam, 1 to 6 percent slopes. This soil is deep, very gently sloping and gently sloping, and well drained. It is on broad to narrow convex ridgetops and side slopes of dissected uplands and formed in very fine sandy loam calcareous loess. The areas of this soil range from 5 to 150 acres in size.

Typically, the surface layer is brown, very friable very fine sandy loam about 5 inches thick. The subsoil is very friable very fine sandy loam about 11 inches thick. It is grayish brown and brown in the upper part and pale brown and calcareous in the lower part. The underlying material extends to a depth of 60 inches or more. It is very pale brown and light gray, calcareous very fine sandy loam in the upper part where lime has accumulated and very pale brown, calcareous very fine sandy loam in the lower part. In some places free carbonates are at the surface.

Included with this soil in mapping are small areas of Busher and Tassel soils. Busher soils have a darker and thicker surface layer than that of the Angora soil. They and the Angora soil are in similar positions on the landscape. Busher soils are also on side slopes at lower elevations. The Tassel soils are shallow and are on moderately steep side slopes at lower elevations. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate. The available water capacity is high. Runoff is medium. The water intake rate for irrigation is moderate. The content of organic matter is moderately low. Tilth is good.

Most of the acreage of this soil is in native grasses and is used as rangeland. Some areas are dry-farmed; others are farmed under irrigation.

This soil is poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil improves the content of organic matter and fertility and maintains tilth.

This soil is poorly suited to irrigated crops, including corn, sugar beets, dry edible beans, and alfalfa. Efficient management of irrigation water is a concern because of slope. The soil is best suited to sprinkler irrigation. Soil blowing and water erosion are severe hazards. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control water erosion and soil blowing, and conserve moisture. Crop residue on the soil increases the content of organic matter and fertility and helps maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock and haying at an improper time reduce the protective cover and cause deterioration of the native plants. Overgrazing also can cause severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that do not have a high moisture requirement. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by timely cultivation between the rows with conventional equipment. Careful use of appropriate herbicides in the rows can also help control undesirable weeds and grasses. Trees can be planted on the contour in combination with terraces to help reduce erosion and excessive runoff of water. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil is generally suited to septic tank absorption fields and to building sites. For sewage lagoons, grading is required to modify the slope and shape of the lagoon; the lagoons need to be lined or sealed to prevent seepage. This soil is generally suited to roads.

This soil is assigned to capability units IVe-9 dryland and IVe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

AnE—Angora very fine sandy loam, 6 to 20 percent slopes. This soil is deep, strongly sloping and moderately steep, and well drained. It is on narrow convex ridgetops and side slopes of dissected uplands. It formed in very fine sandy loam, calcareous loess. The areas of this soil range from 10 to 400 acres in size.

Typically, the surface layer is light brownish gray, friable very fine sandy loam about 5 inches thick. The subsoil is pale brown, friable, calcareous very fine sandy loam about 6 inches thick. To a depth of 60 inches or more, the underlying material is very friable, calcareous very fine sandy loam. It is pale brown in the upper part and very pale brown in the lower part. In some places free carbonates are at the surface.

Included with this soil in mapping are small areas of Busher and Tassel soils and outcrops of sandstone bedrock. Busher soils are sandier, have a thicker and darker surface layer and are on side slopes at lower elevations than the Angora soil. Tassel soils have sandstone bedrock at a depth of 10 to 20 inches and are on steep side slopes at lower elevations. The outcrops of sandstone are on narrow ridgetops and on the steeper part of side slopes. The included soils and the sandstone outcrops make up 10 to 15 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high. The content of organic matter is moderately low.

This soil is mainly in native grasses and is used as rangeland.

This soil is not suited to farming because of the moderately steep slope. Furthermore, soil blowing and water erosion are severe hazards.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is poorly suited to trees and shrubs in windbreaks. Species should be selected that do not have a high moisture requirement. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by timely cultivation between the rows with conventional equipment. Careful use of appropriate herbicides in the rows can also help control undesirable weeds and grasses. Trees can be planted on the contour to help reduce erosion and excessive runoff of water. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

If a septic tank absorption system is to be installed on the Angora soil, land shaping generally is necessary, and the field should be laid out on the contour. If the slope is more than 15 percent, a suitable alternate site should be considered. This soil is generally not suited to sewage lagoons because of the moderately steep slope. Dwellings need to be properly designed to accommodate the slope, or the soil can be graded to an acceptable gradient. Cuts and fills generally are needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-9 dryland. It is in the Silty range site and in windbreak suitability group 3.

Ba—Bankard loamy coarse sand, 0 to 2 percent slopes. This soil is deep, nearly level, and somewhat excessively drained. It is on bottom lands and alluvial fans and is subject to occasional flooding. It formed in stratified sandy calcareous alluvium. The areas of this soil are elongated and range from 5 to 120 acres in size.

Typically, the surface layer is light brownish gray, very friable loamy coarse sand about 5 inches thick. To a depth of 60 inches or more, the underlying material is stratified light gray and light brownish gray coarse sand, loamy fine sand, sand, and loamy very fine sand.

Included with this soil in mapping are small areas of Valent soils. Valent soils are not stratified, are leached of carbonates to a depth of 40 inches or more, and are on hummocks. They make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is very slow. The available water capacity is low, and the water intake rate for irrigation is very high. The content of organic matter is low. Tilth is fair.

Most of the acreage of this soil is in native grasses and is used as rangeland. Some areas are farmed under irrigation. A few small areas are used as pasture.

This soil is not suited to dry-farmed crops. Soil blowing and drought are severe hazards. Flooding is also a hazard.

Under sprinkler irrigation, this soil is poorly suited to corn and alfalfa. Soil blowing is a severe hazard, which the use of a winter cover crop helps reduce. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Irrigation is needed because of the low available water capacity of the soil. Crop residue and feedlot manure on the soil help improve tilth and fertility and increase the content of organic matter.

This soil is poorly suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Efficient use of irrigation water and the use of fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants. Range seeding effectively provides a good vegetative cover to stabilize the soil if the land use is changed from cropland to rangeland.

This soil is poorly suited to coniferous trees in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees need to be planted in a shallow furrow or a narrow roto-tilled strip with little disturbance of the soil. Sod needs to be maintained between the rows and in the rows. The areas near the trees can be hoed by hand. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil is not suited to sanitary facilities because of flooding, and because pollution by seepage could contaminate the underground water. This soil is not suited to use as building sites because of flooding. Suitable alternate sites should be considered. Constructing roads on suitable, well-compacted fill material above the flood level and providing adequate side ditches and culverts help prevent flood damage to the roads.

This soil is assigned to capability units VIe-5 dryland and IVe-12 irrigated. It is in the Sandy Lowland range site and in windbreak suitability group 7.

Bb—Bankard loamy fine sand, 0 to 2 percent slopes. This is a deep, nearly level, somewhat excessively drained soil that formed in stratified sandy calcareous alluvium. It is on bottom lands and is subject to occasional flooding. The areas of this soil are elongated and range from 5 to 170 acres in size.

Typically, the surface layer is light brownish gray, very friable loamy fine sand about 8 inches thick. A transitional layer is light brownish gray, very friable very fine sandy loam about 5 inches thick. The underlying material is stratified light gray and very pale brown loamy sand, loamy fine sand, fine sand, and loamy very fine sand in the upper part and light gray sand to a depth of about 60 inches. In some places the underlying material is noncalcareous.

Included with this soil in mapping are small areas of Glenberg and Valent soils. Glenberg soils contain more silt and less sand and are in about the same positions on the landscape as Bankard loamy fine sand. Valent soils are not stratified, are leached of carbonates to a depth of 40 inches or more, and are on low hummocks. The included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is very slow. The available water capacity is moderate. The water intake rate for sprinkler irrigation using ground water is very high, and for gravity irrigation using canal water it is moderately high. The organic matter content is low. Tilth is fair.

In many areas, this soil is in native grasses and is used as rangeland. In some areas it is farmed. It is used for both irrigated and dryland farming. In a few small areas, this soil is used as pasture.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Flooding is also a hazard. Conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Cover crops also are helpful. Stripcropping helps reduce soil blowing. Crop residue and feedlot manure on the soil help improve tilth and fertility and increase the content of organic matter.

Under irrigation by the sprinkler method, this soil is suited to corn and alfalfa. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Returning crop residue to the soil and applying feedlot manure help improve tilth, the organic matter content, and fertility.

This soil is suited to use as pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture grasses.

This soil is suited to use as rangeland, and this use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by using appropriate herbicides or by hand hoeing or roto-tilling in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally needs to be restricted to the tree rows. Supplemental water, for example, from irrigation by the drip system, may be needed during periods of low rainfall.

This soil is not suited to sanitary facilities because of flooding and because pollution by seepage could contaminate the underground water. This soil is not suited to use as building sites because of flooding. Suitable alternate sites should be considered for these uses. Constructing roads on suitable, well-compacted fill material above the flood level and providing adequate side ditches and culverts help prevent flood damage to the road.

This soil is assigned to capability units IVe-5 dryland, IVe-11 where irrigated by sprinklers, and IVe-8 where irrigated by a gravity system. It is in the Sandy Lowland range site and in windbreak suitability group 5.

Bc—Bankard fine sand, channeled. This is a deep, very gently sloping, somewhat excessively drained soil. It formed in stratified sandy alluvium on bottom lands that are dissected by stream channels. It is subject to frequent flooding. The intermittent stream channels, making up about 30 percent of the mapped areas, have sparse vegetation and are lower on the landscape. The areas of this soil are long and narrow and range from 5 to 300 acres in size. Slopes are mainly 0 to 3 percent.

Typically, the surface layer is light brownish gray, very friable fine sand about 4 inches thick. The underlying material, to a depth of more than 60 inches, is light gray, stratified coarse sand, very gravelly coarse sand, and loamy very fine sand. In some places the surface layer is darker and thicker than is typical.

Included with this soil in mapping are small areas of Glenberg and Valent soils. Glenberg soils are well drained. They have less sand and more silt than the Bankard soil. They are on bottom lands that are slightly higher on the landscape than areas of the Bankard soil. The Valent soils are deep and do not have appreciable amounts of gravel. They are on hummocks on stream terraces and on uplands. The included soils make up about 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity and the content of organic matter are low.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland.

This soil is not suited to use as farmland because flooding is a severe hazard and because of the high drought potential due to the low available water capacity of the soil. Generally, it is not practical to overcome the flooding hazard or to improve the available water capacity of the soil.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants on the channeled areas.

This soil is generally not suited to trees and shrubs in windbreaks because the soil is too droughty and is subject to frequent flooding.

This soil generally is not suited to sanitary facilities and building sites because of flooding. A suitable alternate site should be considered. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to the roads from flooding.

This soil is assigned to capability unit VIw-4 dryland. It is in the Shallow to Gravel range site and in windbreak suitability group 10.

Be—Barney loam, 0 to 1 percent slopes. This soil is shallow over gravelly sand and gravelly coarse sand. It is nearly level and poorly drained. It formed in alluvial material on bottom lands and is subject to frequent flooding, especially when ice jams occur in the North Platte River channels. The areas of this soil are commonly dissected by old, shallow, abandoned stream channels and range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, very friable loam about 7 inches thick. The underlying material is white gravelly sand in the upper part and white gravelly coarse sand in the lower part. It extends to a depth of 60 inches or more. In some places the dark surface layer is less than 7 inches thick. Also, in places the depth to gravelly sand is more than 20 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Gothenburg, Platte, and Yockey soils. The Gothenburg and the Platte soils are on bottom lands at higher elevations than the Barney soil. The Yockey soils are deep. They have a lower water table and are at higher elevations. Also there are some shallow water areas. The inclusions make up 5 to 15 percent of the map unit.

Permeability is moderately rapid in the surface layer and in a transitional layer and rapid in the underlying material. Runoff is very slow. The available water capacity is low. The apparent seasonal high water table is at a depth that ranges from the surface to 2 feet. The content of organic matter is moderate. The root zone is shallow.

Nearly all the acreage of this soil is in native grasses and is used as hayland.

This soil is not suited to use as farmland because of wetness caused by the high water table and because of flooding. Generally, it is not practical to overcome the wetness limitation or flooding hazard.

This soil is suited to use as rangeland. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet can cause small mounds to form. The mounds make grazing or harvesting for hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition.

This soil is generally not suited to trees and shrubs in windbreaks because of wetness.

This soil is suited to wetland plants that provide food and cover for wetland wildlife.

This soil is not suited to septic tank absorption fields because of flooding. Wetness and pollution by seepage could contaminate the underground water. A suitable alternate site, therefore, should be considered. Sewage lagoons need to be lined or sealed to prevent seepage and need to be diked to prevent damage to the lagoons from flooding. Lagoons also need to be constructed on fill material in order to raise the bottom of the lagoon to a sufficient height above the seasonal high water table. The soil is not suitable for use as building sites because of flooding and wetness; therefore, a suitable alternate site should be considered. Constructing roads on suitable, well-compacted fill material above the flood level and providing adequate side ditches and culverts help prevent flood damage and wetness.

This soil is assigned to capability unit Vw-7 dryland. It is in the Wet Land range site and in windbreak suitability group 10.

Bg—Bridget very fine sandy loam, 0 to 1 percent slopes. This is a deep, nearly level, well drained soil that formed in colluvial-alluvial sediment. It is on broad foot slopes of valleys. The areas range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 14 inches thick. A transitional layer is pale brown, very friable, calcareous very fine sandy loam about 8 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of 60 inches or more. In some places the surface layer is finer textured than is typical and is more than 20 inches thick. Also, in some places the surface layer and the transitional layer contain more sand.

Included with this soil in mapping are small areas of very gently sloping Mitchell and Otero soils. These soils and the Bridget soil are in about the same positions on the landscape. Mitchell and Otero soils have a lighter colored surface layer; Otero soils have more sand and less silt. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high, and the water intake rate for irrigation is moderate. The organic matter content is moderate. Tilth is good.

Nearly all of the acreage of this soil is farmed. Most areas are irrigated; some are dry-farmed.

This soil is suited to dry-farmed winter wheat. The lack of precipitation is the major limitation, although, soil blowing and water erosion are slight hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil increases the content of organic matter and fertility and maintains tilth.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Land leveling increases the efficiency of a gravity irrigation system. A sprinker system also increases the efficiency of irrigation. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth and the water-intake rate and increase the content of organic matter and fertility, especially if the soil has been disturbed by land leveling.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Irrigating efficiently and applying fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture grasses.

This soil is suited to trees and shrubs in windbreaks. Seedlings usually survive if competing vegetation is controlled or removed by good site preparation and by careful use of appropriate herbicides in the tree rows. Undesirable weeds and grasses also can be controlled by cultivation between the rows with conventional equipment. Areas in the row or near small trees can be hoed by hand or roto-tilled. Trees can be planted on the contour to help reduce erosion and runoff of water. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIc-1 dryland and I-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

BgB—Bridget very fine sandy loam, 1 to 3 percent slopes. This is a deep, very gently sloping, well drained soil that formed in colluvial-alluvial sediments. It is on broad slopes of valleys. The areas range from 5 to 150 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 8 inches thick. The subsurface layer is brown, very friable very fine sandy loam about 5 inches thick. A transitional layer is pale brown, very friable, calcareous very fine sandy loam about 13 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of 60 inches or more. In some places the transitional layer contains more sand.

Included with this soil in mapping are small areas of nearly level Duroc soils, gently sloping Mitchell soils, and Otero soils. Duroc soils are lower on the landscape. They have a dark surface soil that is more than 20 inches thick. Mitchell and Otero soils have a lighter colored surface layer. They are in positions similar to those of the Bridget soil. Otero soils have more sand and less silt. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is farmed. Many areas are irrigated, but some are dry-farmed. A few small areas in grasses are used as pasture.

This soil is suited to dry-farmed winter wheat. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps prevent soil blowing. Crop residue on the soil increases the content of organic matter, improves fertility, and helps maintain tilth.

Under irrigation, this soil is suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Efficient management of irrigation water is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. Sprinkle irrigation is the system that is best suited to this soil. Soil blowing is a slight hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the water intake rate, the content of organic matter, and fertility, especially if this soil has been disturbed by land leveling.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Efficient use of irrigation water and the use of fertilizer in amounts based on soil tests are concerns in management. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture grasses.

This soil is suited to trees and shrubs in windbreaks. Seedlings usually survive if competing vegetation is controlled or removed by good site preparation and by careful use of appropriate herbicides in the tree rows. Undesirable weeds and grasses also can be controlled by cultivating between the rows with conventional equipment. The areas in the rows or near small trees can be hoed by hand or roto-tilled. Trees planted on the contour help reduce erosion and runoff. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. Grading is required to modify the slope and shape the lagoon. Good surface drainage can reduce damage to roads by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIe-1 dryland and IIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

BgC—Bridget very fine sandy loam, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed in colluvial-alluvial sediments on foot slopes of valleys. The areas range from 5 to 40 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 8 inches thick. The subsurface layer is grayish brown, very friable, calcareous very fine sandy loam about 7 inches thick. A transitional layer is grayish brown, very friable, calcareous very fine sandy loam about 6 inches thick. The underlying material is pale brown, calcareous very fine sandy loam to a depth of 60 inches or more. In some places the surface layer is lighter in color than is typical.

Included with this soil in mapping are small areas of very gently sloping Duroc soils. Duroc soils are in lower positions on the landscape than the Bridget soil. They are finer textured and have a dark surface soil that is more than 20 inches thick. They make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderate. The organic matter content is moderate. Tilth is good.

Much of the acreage of this soil is farmed. The areas are either irrigated or dry-farmed. Some areas in native grasses are used as rangeland.

This soil is suited to dry-farmed winter wheat. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil increases the organic matter content, improves fertility, and maintains tilth.

If sprinkler irrigation is used, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps increase the organic matter content, improves fertility, and helps maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings usually survive if competing vegetation is controlled or removed by good site preparation and by careful use of appropriate herbicides in the tree rows. Undesirable weeds and grasses can also be controlled by cultivating between the rows with conventional equipment. The areas in the rows or near small trees can be hoed by hand or roto-tilled. Trees planted on the contour help reduce erosion and runoff. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. Grading is required to modify the slope and shape the lagoon. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIe-1 dryland and IIIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

BgD—Bridget very fine sandy loam, 6 to 9 percent slopes. This soil is deep, strongly sloping, and well drained. It formed in colluvial-alluvial sediments on foot slopes and convex side slopes of valleys. The areas range from 5 to 140 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 11 inches thick. A transitional layer is light brownish gray, very friable, calcareous very fine sandy loam about 5 inches thick. The underlying material extends to a depth of 60 inches or more. It is pale brown, calcareous very fine sandy loam in the upper part and very pale brown, calcareous silt loam in the lower part. In some places the transitional layer is finer textured than is typical. Also, in places the surface layer is lighter in color.

Included with this soil in mapping are small areas of Alice soils and gently sloping Duroc soils. Alice soils have more sand and less silt than the Bridget soil; they are on stream terraces. Duroc soils are finer textured than the Bridget soil, and they have a dark surface soil that is more than 20 inches thick. They are on foot slopes at lower positions on the landscape. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is in native grasses and is used as rangeland; however, some areas are farmed.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, help control soil blowing and water erosion, and help conserve moisture. Cover crops also help. Stripcropping helps reduce soil blowing, and terraces help reduce water erosion. Crop residue on the soil increases the content of organic matter, improves fertility, and helps maintain tilth.

If sprinkler irrigation is used, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Efficient management of irrigation water is a concern because of excessive slope. Soil blowing and water erosion are severe hazards. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, help control water erosion and soil blowing, and help conserve moisture. Crop residue on the soil increases the content of organic matter, improves fertility, and helps maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding is generally needed if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Seedlings usually survive if competing vegetation is controlled or removed by good site preparation and by the careful use of appropriate herbicides in the tree rows. Undesirable weeds and grasses can also be controlled by cultivating between the rows with conventional equipment. The areas in the rows or near small trees can be hoed by hand or roto-tilled. Trees planted on the contour help reduce erosion and runoff. Terraces are also helpful. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally suited to septic tank absorption fields and dwellings. For sewage lagoons, extensive grading is required to modify the slope and shape the lagoon, and the lagoons need to be lined or sealed to prevent seepage. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IVe-1 dryland and IVe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

BgE—Bridget very fine sandy loam, 9 to 20 percent slopes. This soil is deep, moderately steep, and well drained. It formed in colluvial-alluvial sediments on convex side slopes and on concave foot slopes of valleys. The areas range from 10 to 40 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 7 inches thick. A transitional layer is light brownish gray, very friable very fine sandy loam about 8 inches thick. The underlying material is very pale brown and calcareous to a depth of 60 inches or more. It is fine sandy loam in the upper part and very fine sandy loam in the lower part.

Included with this soil in mapping are small areas of Mitchell and Otero soils. Mitchell soils have a surface layer that is lighter in color than that of the Bridget soil. Otero soils have more sand than the Bridget soil. The Mitchell and Otero soils are in positions similar to those of the Bridget soil. The included soils make up about 10 to 15 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high. The content of organic matter is moderate.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland.

This soil is generally not suited to use as cropland because of the moderately steep slope and because soil blowing and water erosion are hazards. The hazards and limitations are difficult or impractical to overcome.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings usually survive if competing vegetation is controlled or removed by good site preparation and by careful use of appropriate herbicides in the tree rows. The areas in the rows or near small trees can be hoed by hand or roto-tilled. Trees planted on the contour reduce erosion and excessive runoff. Growth may be somewhat slower on the steepest slopes. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally not suited to sanitary facilities because of the moderately steep slope; therefore, a suitable alternate site should be considered. Dwellings need to be designed to accommodate the slope, or the soil needs to be graded to an acceptable gradient. Cuts and fills are generally needed to provide a suitable grade for roads. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability unit VIe-1 dryland. It is in the Silty range site and in windbreak suitability group 3.

BtC—Busher loamy very fine sand, 1 to 6 percent slopes. This soil is deep, very gently sloping and gently sloping, and well drained. It is on broad convex ridgetops and side slopes of uplands and formed in material that weathered from fine-grained sandstone bedrock. The areas of this soil typically range from 5 to 350 acres in size; however, there is one area of 840 acres.

Typically, the surface layer is brown, very friable loamy very fine sand about 11 inches thick. The subsoil is brown, very friable loamy very fine sand about 8 inches thick. The underlying material is pale brown loamy very fine sand in the upper part and very pale brown loamy very fine sand in the lower part. Weakly cemented, fine-grained, limy sandstone is at a depth of 41 inches. In some places the subsoil is higher in clay content than is typical.

Included with this soil in mapping are small areas of Tassel and Vetal soils and outcrops of sandstone bedrock and gravel. Tassel soils are shallow and are on the higher ridgetops. Vetal soils have a dark surface soil that is more than 20 inches thick. They are in small depressions and concave areas. Outcrops of limy sandstone are on narrow ridgetops and sharp slope breaks. Outcrops of gravel are on small knobs in higher positions on the landscape than the Busher soil. The included soils and the outcrops make up 10 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate, and the water intake rate for irrigation is very high. The content of organic matter is moderately low. Tilth is good.

Most of the acreage of this soil is in native grasses and is used as rangeland. A few small areas are farmed.

This soil is poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices keep crop residue on the surface, control soil blowing, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil improves the organic matter content and fertility and maintains tilth.

Under irrigation, this soil is poorly suited to crops, including corn and alfalfa. Efficient management of irrigation water is a concern because of slope. Sprinkler irrigation is the method best suited to this soil. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil improves the organic matter content and fertility and maintains tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding effectively reduces soil loss if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by the use of herbicides. Areas in the tree rows can be hoed by hand or roto-tilled. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

Increasing the size of the septic tank absorption field will generally overcome the limitation of weakly cemented bedrock that is at a depth of 40 to 60 inches. Sewage lagoons can be constructed in areas of this soil if the bottom of the lagoon is sealed to prevent seepage. The weakly cemented bedrock must be excavated if dwellings with basements or buildings with deep foundations are constructed. This soil is generally suited to roads.

This soil is assigned to capability units IVe-3 dryland and IVe-11 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

BtE—Busher loamy very fine sand, 9 to 20 percent slopes. This soil is deep, moderately steep, and well drained. It formed in materials that weathered from fine-grained sandstone bedrock and is on convex side slopes of uplands. The areas range from 5 to 150 acres in size.

Typically, the surface layer is brown, very friable loamy very fine sand about 10 inches thick. The subsoil is brown, soft loamy very fine sand about 8 inches thick. The underlying material is pale brown, fine sandy loam to a depth of 56 inches. Below that, there is white, weakly cemented, fine-grained, limy sandstone.

Included with this soil in mapping are small areas of Tassel and Vetal soils and outcrops of sandstone bedrock. The shallow Tassel soils are on ridgetops. Vetal soils have a dark surface soil that is more than 20 inches thick. Vetal soils are in concave areas. The outcrops of limy sandstone bedrock are on narrow ridgetops and sharp slope breaks. The included soils and the areas of outcrops make up 10 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate. The content of organic matter is moderately low.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland.

This soil is not suited to use as cropland because of the moderately steep slope and soil blowing. Generally, it is not practical to prevent soil blowing or to overcome the slope limitation under a system of cultivation.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

This soil is poorly suited to trees in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees need to be planted in a shallow furrow or a narrow roto-tilled strip with as little disturbance of the soil as possible, and sod needs to be maintained between the tree rows. The areas near the trees can be hoed by hand. Planting on the contour and maintaining strips of sod between the rows can reduce water erosion. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil generally is not suited to sanitary facilities because of moderately steep slopes; therefore, a suitable alternate site should be considered. Dwellings need to be properly designed to accommodate the slope, or the soil needs to be graded to an acceptable gradient. The weakly cemented bedrock must be excavated if dwellings with basements are constructed. Cuts and fills generally are needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-3 dryland. It is in the Sandy range site and in windbreak suitability group 7.

BuC—Busher very fine sandy loam, 1 to 6 percent slopes. This soil is deep, very gently sloping and gently sloping, and well drained. It formed on broad convex ridgetops of uplands in materials that weathered from fine-grained sandstone bedrock. The areas of this soil range from 5 to 70 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 16 inches thick. The subsoil is light brownish gray, very friable very fine sandy loam about 13 inches thick. The underlying material is light gray very fine sandy loam. It extends to a depth of 46 inches. Below that, there is white, weakly cemented, fine-grained sandstone. In some places the surface layer is thinner and lighter in color than is typical. Also, in places the surface layer is more than 20 inches thick. In places the subsoil is finer textured.

Included with this soil in mapping are small areas of Dix and Tassel soils and fragments of sandstone and rock outcrop. Dix soils are excessively drained and are shallow over very gravelly coarse sand. Tassel soils are shallow and have a lighter colored calcareous surface layer. Dix and Tassel soils are in positions similar to those of the Busher soil. The concentrations of calcareous sandstone fragments and rock outcrop are on small knobs and narrow ridgetops. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate, and the water intake rate for irrigation is also moderate. The organic matter content is moderately low. Tilth is good.

This soil is farmed, or it is in native grasses and used as rangeland. Dry farming is common.

This soil is suited to dry-farmed winter wheat and millet. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Conservation tillage practices, stubble mulching for example, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Cover crops also help. Stripcropping helps reduce soil blowing. Terraces help prevent water erosion. Crop residue on the soil increases the content of organic matter and helps maintain tilth and fertility.

If sprinkler irrigation water is used, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Efficient management of irrigation water is a concern because of the slope. Land leveling increases the efficiency of a gravity irrigation system. Soil blowing is a moderate hazard. A winter cover crop on the soil helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps improve the organic matter content and helps maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding effectively reduces soil loss if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees can be planted on the contour in combination with terraces to help reduce erosion and excessive runoff of water. Areas between the rows can be cultivated with conventional equipment, and areas in the rows or near small trees can be hoed by hand or roto-tilled. Careful use of appropriate herbicides in the rows helps control undesirable weeds and grasses. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

Increasing the size of the septic tank absorption field will generally overcome the limitation of weakly cemented bedrock that is at a depth of 40 to 60 inches. Sewage lagoons can be constructed in areas of this soil if the bottom of the lagoon is sealed to prevent seepage. The weakly cemented bedrock must be excavated if dwellings with basements or buildings with deep foundations are constructed. This soil generally is suitable for roads.

This soil is assigned to capability units IIIe-1 dryland and IIIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 5.

BuD—Busher very fine sandy loam, 6 to 9 percent slopes. This soil is deep, strongly sloping, and well drained. It formed on ridgetops and on dissected side slopes of uplands in materials that weathered from fine-grained sandstone bedrock. The areas of this soil range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, very friable, very fine sandy loam about 4 inches thick. The subsurface layer is grayish brown, very friable loam also about 4 inches thick. The subsoil is pale brown, very friable loam about 16 inches thick. The underlying material is very pale brown loam to a depth of 50 inches. Below that, there is very pale brown, weakly cemented fine-grained sandstone. In some places the surface layer is calcareous. Also, in places the surface layer is light brownish gray about 5 inches thick.

Included with this soil in mapping are small areas of Dix, Duroc, and Tassel soils and outcrops of sandstone bedrock. Dix soils are excessively drained and are shallow over very gravelly coarse sand. Dix and Busher soils are in similar positions on the landscape. Unlike the Busher soil, Duroc soils do not have bedrock at a depth of 50 to 60 inches; they are on concave foot slopes. Tassel soils are shallow. They have a calcareous surface layer that is lighter in color than that of the Busher soil. Tassel soils are on breaks of ridgetops. Outcrops of sandstone are on sharp slope breaks and narrow ridgetops. The included soils and the outcrops make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate, and the water intake rate for irrigation also is moderate. The content of organic matter is moderately low. Tilth is good.

Most of the acreage of this soil is in native grasses and is used as rangeland. Some areas are dry-farmed.

This soil is poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Terraces help reduce water erosion. Crop residue on the soil helps improve the organic matter content and helps maintain tilth and fertility.

If sprinkler irrigation is used, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps improve the organic matter content and helps maintain tilth and fertility.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding effectively reduces soil loss if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees can be planted on the contour in combination with terraces to help reduce erosion and the excessive runoff of water. The areas between the tree rows can be cultivated with conventional equipment, and the areas in the tree rows or near small trees can be hoed by hand or roto-tilled. Using appropriate herbicides in the tree rows helps control undesirable weeds and grasses. Irrigation by the drip system can provide supplemental water during periods of low rainfall.

This soil is suitable for wild herbaceous plants and shrubs that provide food and cover for rangeland wildlife.

Increasing the size of the septic tank absorption field generally overcomes the limitation of weakly cemented bedrock that is at a depth of 40 to 60 inches. Sewage lagoons can be constructed on this soil if the bottom of the lagoon is sealed to prevent seepage. The weakly cemented bedrock needs to be excavated if dwellings that have basements or buildings that have deep foundations are constructed. This soil generally is suitable for roads.

This soil is assigned to capability units IVe-1 dryland and IVe-6 irrigated. It is in the Silty range site and in windbreak suitability group 5.

BuE—Busher very fine sandy loam, 9 to 20 percent slopes. This soil is deep, moderately steep, and well drained. It formed on dissected side slopes and ridgetops of uplands in material that weathered from fine-grained sandstone bedrock. The areas of this soil range from 10 to 140 acres in size.

Typically, the surface layer is grayish brown, very friable, very fine sandy loam about 10 inches thick. The subsoil is pale brown, friable very fine sandy loam about 13 inches thick. The underlying material, to a depth of 47 inches, is very fine sandy loam. It is pale brown in the upper part and very pale brown in the lower part. Below that, there is white, soft, fine-grained, limy sandstone. In some places the subsoil has more silt and less sand than is typical.

Included with this soil in mapping are small areas of Tassel soils and outcrops of sandstone bedrock. Tassel soils are shallow and have a calcareous surface layer that is lighter in color than that of the Busher soil. Tassel soils are on the lower part of side slopes. Outcrops of sandstone are on sharp slope breaks and narrow ridgetops. The included soils and the outcrops make up about 10 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is rapid. The available water capacity is moderate. The content of organic matter is moderately low.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland.

This soil is generally not suited to use as cropland because of the moderately steep slopes, soil blowing, and very severe water erosion.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover, causes deterioration of the native plants, and results in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees can be planted on the contour to help reduce erosion and control excessive runoff of water. Growth may be somewhat slower on the steepest slopes. The careful use of appropriate herbicides helps control undesirable weeds and grasses. The areas between the tree rows or near small trees can be hoed by hand or roto-tilled. Irrigation by the drip system can be used during periods of low rainfall to provide supplemental water.

This soil generally is not suited to sanitary facilities because of the moderately steep slopes. An alternate site should be considered. Dwellings need to be designed to accommodate the slope, or the soil needs to be graded to an acceptable gradient. The weakly cemented bedrock must be excavated if dwellings with basements are constructed. Cuts and fills generally are necessary to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-1 dryland. It is in the Silty range site and in windbreak suitability group 7.

BxD—Busher-Tassel loamy very fine sands, 3 to 9 percent slopes. This map unit consists of gently sloping and strongly sloping, well drained soils on uplands dissected by drainageways. The Busher soil is deep and is on broader parts of convex ridgetops and smooth, convex side slopes. The Tassel soil is shallow and is on narrow upland ridgetops, sharp slope breaks, and the upper part of side slopes. These soils formed in material that weathered from fine-grained sandstone. The soils are in areas so intricately mixed or so small in size that it is not practical to map them separately. The mapped areas range from 5 to 140 acres in size and are made up of 45 to 75 percent Busher soil and 15 to 35 percent Tassel soil.

Typically, the Busher soil has a surface layer of grayish brown, very friable loamy very fine sand about 15 inches thick. The subsoil is light brownish gray, very friable fine sandy loam about 13 inches thick. The underlying material, to a depth of 41 inches, is light gray, calcareous fine sandy loam. Below that, there is white, weakly cemented calcareous sandstone. In some places the surface layer is coarser textured, lighter in color, or thinner than is typical. Also, in places the carbonates are leached and the subsoil is higher in clay content.

Typically, the Tassel soil has a surface layer of grayish brown, very friable, calcareous loamy very fine sand about 9 inches thick. The underlying material is light brownish gray, calcareous fine sandy loam to a depth of 16 inches. Below that, to a depth of more than 26 inches, there is white, weakly cemented, calcareous sandstone bedrock. In some places the sandstone bedrock is at a depth of less than 10 inches.

Included with these soils in mapping are small areas of Dix and Duroc soils and outcrops of soft sandstone bedrock. Dix soils are excessively drained and are shallow over very gravelly coarse sand. They and the Busher and Tassel soils are in similar positions on the landscape. Duroc soils are finer textured than the Busher and Tassel soils and are in concave areas and on foot slopes. The outcrops are on narrow ridgetops and sharp slope breaks. In places the sandstone is high in clay. The included soils and the outcrops make up 10 to 20 percent of the map unit.

Permeability of these soils is moderately rapid. Runoff is slow. The available water capacity of the Busher soil is moderate, and that of the Tassel soil is very low. The organic matter content of the Busher soil is moderately low, and that of the Tassel soil is low. The root zone of the Busher soil is deep, and that of the Tassel soil is shallow. Tilth of the Busher soil is good, and that of the Tassel soil is fair.

Much of the acreage of these soils is in native grasses and is used as rangeland. Some areas are used for farming. Nearly all farming is dryland.

These soils are poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing is a severe hazard where the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on these soils helps improve tilth and maintain the content of organic matter.

If sprinkler irrigation is used, these soils are poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Soil blowing is a severe hazard; however, a winter cover crop helps reduce soil blowing. The very low available water capacity of the shallow Tassel soil has to be considered if irrigation is used. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on these soils helps maintain or improve the fertility.

This soil is suited to use as rangeland, and this use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. A proper grazing system helps maintain or improve the range condition. Brush management may be needed to control undesirable woody plants. Range seeding effectively reduces soil loss if the land use is changed from cropland to rangeland.

The Tassel soil is generally not suited to trees and shrubs in windbreaks because it is too shallow. The Busher soil is suited; however, onsite investigation is needed before planning a windbreak, and species should be selected that can moderately tolerate drought and that can grow in sandy soil. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by the appropriate use of herbicides. The areas in the tree row can be hoed by hand or roto-tilled. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Irrigation by the drip system is one efficient way to provide supplemental water during periods of low rainfall.

Onsite investigation is needed for all engineering construction on the soils of this map unit. Increasing the size of the septic tank absorption fields generally overcomes the limitation of weakly cemented sandstone at a depth of 40 to 60 inches. The Tassel soil generally is not suitable for septic tank absorption fields and sewage lagoons because of shallowness to bedrock. A suitable alternate site should be considered. On the Busher soil, sewage lagoons need to be lined or sealed to prevent seepage. On Busher and Tassel soil, the weakly cemented bedrock must be excavated if dwellings with basements are to be constructed. On the Tassel soils, it is necessary to excavate the weakly cemented bedrock before building roads.

These soils are assigned to capability units IVe-3 dryland and IVe-6 irrigated. The Busher soil is in the Sandy range site, and the Tassel soil is in the Shallow Limy range site. The Busher soil is in windbreak suitability group 7, and the Tassel soil is in windbreak suitability group 10.

BxE—Busher-Tassel loamy very fine sands, 9 to 20 percent slopes. This map unit consists of moderately steep soils on uplands. The deep Busher soil is on ridgetops and convex side slopes. The shallow Tassel soil is on narrow ridges, sharp slope breaks, and dissected side slopes. These soils formed in material that weathered from fine-grained sandstone. The soils are in areas so intricately mixed or so small in size that it is not practical to map them separately. The mapped areas range from 5 to 185 acres in size and are made up of 40 to 65 percent Busher soil and 20 to 40 percent Tassel soil.

Typically, the Busher soil has a surface layer of brown, very friable loamy very fine sand about 11 inches thick. The subsoil is pale brown, very friable loamy very fine sand about 11 inches thick. The underlying material is very pale brown loamy very fine sand. Below that, at a depth of 41 inches, there is white, weakly cemented, limy sandstone. In some places the carbonates are leached and the subsoil is higher in clay content. Also, in places the surface layer is lighter in color and thinner than is typical.

Typically, the Tassel soil has a surface layer of light brownish gray, very friable, calcareous loamy very fine sand about 4 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of 11 inches. Below that, to a depth of more than 24 inches, there is white, weakly cemented, limy sandstone. In some places the sandstone bedrock is at a depth of less than 10 inches.

Included with these soils in mapping are small areas of Vetal soils, outcrops of gravel, and outcrops of sandstone bedrock. Vetal soils have a dark surface soil that is more than 20 inches thick. They are in small concave areas. The outcrops of gravel are on small knobs at higher elevations, and the outcrops of sandstone are on narrow ridgetops and sharp slope breaks. The included soils and the outcrops make up 10 to 20 percent of the map unit.

Permeability of these soils is moderately rapid. Runoff is medium. The available water capacity of the Busher soil is moderate and that of the Tassel soil is very low. The content of organic matter of the Busher soil is moderately low, and that of the Tassel soil is low. The root zone of the Tassel soil is shallow.

Nearly all of the acreage of these soils is in native grasses. Most areas are used as rangeland. There are scattered trees in a few small areas.

These soils are generally not suited to farming because of the moderately steep slope and soil blowing. Generally, it is not practical to control soil blowing or to overcome the slope limitation under a system of cultivation.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It also results in severe losses by soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be necessary to control undesirable woody plants.

The Busher soil is suited to trees in windbreaks. The Tassel soil is not suited to trees and shrubs in windbreaks. Onsite investigation is necessary before planning a windbreak on these soils. For the Busher soil, species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees should be planted in a shallow furrow or a narrow roto-tilled strip, and the soil should be disturbed as little as possible. The areas near the trees can be hoed by hand. Planting on the contour and maintaining strips of sod between the rows can reduce water erosion. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is an efficient way to supply it.

Onsite investigation is needed for all engineering construction on the soils of this map unit. The soils generally are not suited to sanitary facilities because of the steep slopes. Moreover, the Tassel soil is shallow to bedrock. A suitable alternate site should be considered. Dwellings on these soils should be designed to accommodate the slope, although the Busher soil can be graded to an acceptable gradient. On the Tassel soil, it is necessary to excavate the weakly cemented bedrock prior to construction of dwellings. Cuts and fills generally are necessary to provide a suitable grade for roads.

These soils are assigned to capability unit VIe-3 dryland. The Busher soil is in the Sandy range site, and the Tassel soil is in the Shallow Limy range site. The Busher soil is in windbreak suitability group 7, and the Tassel soil is in windbreak suitability group 10.

Cf—Craft loamy very fine sand, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It is subject to occasional flooding. It formed in stratified calcareous alluvium on bottom lands. The areas range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, friable loamy very fine sand about 9 inches thick. The subsurface layer is light brownish gray, friable, calcareous very fine sandy loam about 10 inches thick. The underlying material is stratified light brownish gray, gray, and light gray, calcareous very fine sandy loam and loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Glenberg and McCook soils. Glenberg soils have more sand than the Craft soil, and McCook soils have a darker surface layer. McCook soils are subject to rare flooding. They and Glenberg soils and the Craft soil are in similar positions on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high. The seasonal high water table is at a depth that ranges from about 6 feet to about 10 feet. During wet years, in the spring in some places the high water table is at a depth of about 6 feet. The water intake rate for irrigation is high. The content of organic matter is low. The Craft soil is strongly alkaline below a depth of about 32 inches. Tilth is fair.

Most of the acreage of this soil is farmed. Most areas are irrigated, but some are dry-farmed. A few small areas in grasses are used as pasture.

This soil is suited to dry-farmed winter wheat. Soil blowing is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue and feedlot manure on the soil improve tilth and fertility and increase the content of organic matter.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation is efficient also. Soil blowing is a moderate hazard. Winter cover crops help reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop or feedlot manure and crop residue improve tilth, the water intake rate, the organic matter content, and fertility, especially where the soil has been disturbed by land leveling.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and improper haying methods reduce the growth and vigor of the plants. Efficient use of irrigation water and the use of fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by applying selected, appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Irrigation by the drip system, for example, can provide supplemental water during periods of low rainfall.

This soil is not suited to sanitary facilities or to building site development because of flooding. A suitable alternate site should be considered. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage.

This soil is assigned to capability units IIIe-3 dryland and IIIe-10 irrigated. It is in the Sandy Lowland range site and in windbreak suitability group 5.

Cg—Craft very fine sandy loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It is subject to occasional flooding. It formed on bottom lands in stratified calcareous alluvium. The areas range from 5 to 110 acres in size.

Typically, the surface layer is light brownish gray, friable, calcareous very fine sandy loam about 14 inches thick. The underlying material is stratified light gray, light brownish gray, and pale brown, calcareous very fine sandy loam, loam, silt loam, and silty clay loam to a depth of more than 60 inches. In some places the surface layer is darker than is typical.

Included with this soil in mapping are small areas of Glenberg and Yockey soils. Glenberg soils contain more sand and less silt than the Craft soil. Yockey soils are somewhat poorly drained. Glenberg and Yockey soils are in positions on the landscape similar to those of the Craft soil. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high. The apparent seasonal high water table is at a depth of about 6 feet to about 10 feet. During wet years, in the spring in some places the high water table is at a depth of about 6 feet. The water intake rate for irrigation is moderate. The content of organic matter is moderately low. Tilth is good.

Most of the acreage of this soil is farmed. Most areas are irrigated; some are dry-farmed. A few small areas in grass are used as pasture.

This soil is suited to dry-farmed winter wheat. The lack of precipitation is the major limitation, although soil blowing is a slight hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil helps increase the content of organic matter and fertility and helps maintain tilth.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. A sprinkler system increases the efficiency of irrigation. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps increase the content of organic matter and fertility and helps maintain tilth.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Irrigating efficiently and applying fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

The soil is suited to trees and shrubs in windbreaks. Seedlings usually survive if competing vegetation is controlled or removed by good site preparation and by timely cultivation between the rows with conventional equipment. Hand hoeing, roto-tilling, and applying selected, appropriate herbicides in the tree rows are useful. Irrigation by the drip system, for example, can provide supplemental water during periods of low rainfall.

This soil is not suited to septic tank absorption fields or building sites because of flooding. Suitable alternate sites should be considered. Sewage lagoons should be diked to prevent damage from flooding. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent flood damage to roads.

This soil is assigned to capability units IIIc-1 dryland and I-6 irrigated. It is in the Silty Lowland range site and in windbreak suitability group 1.

Ch—Craft very fine sandy loam, alkali, 0 to 1 percent slopes. This alkali soil is deep, nearly level, and well drained. It formed in stratified calcareous alluvium on bottom lands and is subject to rare flooding. The areas of this soil range from 5 to 500 acres in size.

Typically, the surface layer is light brownish gray, very friable, calcareous very fine sandy loam about 11 inches thick. The underlying material is stratified light gray, light brownish gray, pale brown, and very pale brown, calcareous very fine sandy loam to a depth of 60 inches or more. The underlying material is strongly alkaline in the upper part and very strongly alkaline in the lower part. In some places, carbonates are leached from the surface layer.

Included with this soil in mapping are small areas of Glenberg, Janise, and Yockey alkali soils. Glenberg soils have more sand and less silt than the Craft soil. Janise and Yockey alkali soils are somewhat poorly drained and subject to occasional flooding. All of these soils are in slightly lower positions on the landscape. In places, the seasonal high water table is within 4 feet of the surface in the spring of wet years. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is moderate. The apparent seasonal high water table is at a depth between 6 feet and 10 feet. During wet years, in the spring in some places the high water table is at a depth of about 4 feet. The organic matter content is moderately low. The water intake rate for irrigation is moderate. Tilth is fair. This soil contains detrimental amounts of sodium and other salts.

This soil is used mainly as rangeland and cropland. Most of the farmed areas are irrigated, but some are dry-farmed. Some areas that are in grasses are used as pasture.

This soil is poorly suited to dry-farmed crops because of the saline-alkali soil condition. Soil blowing is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, for example stubble mulching, help keep crop residue on the surface, control soil blowing, and conserve moisture. Stripcropping helps prevent soil blowing. Crop residue and feedlot manure on the soil help improve tilth, the infiltration of water, fertility, and the content of organic matter.

If sprinkler irrigation is used, the soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The strongly alkaline underlying material of this soil restricts its use. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue and feedlot manure on the soil help improve tilth, the infiltration of water, the organic matter content, and fertility.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Irrigating efficiently and applying fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture. The saline-alkali characteristic of this soil restricts it to plants that can tolerate excess salts and strongly alkaline conditions.

This soil is suited to rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. The saline-alkali condition is a limitation.

This soil is poorly suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately saline or alkaline condition. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Undesirable weeds and grasses can be controlled by maintaining strips of sod between the tree rows and in the row. The areas close to trees can be hoed by hand or roto-tilled. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

The hazard of rare flooding should be taken into account before sanitary facilities and building sites are planned on this soil. Sewage lagoons need to be diked to prevent damage from flooding and lined or sealed to prevent seepage. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from flooding.

This soil is assigned to capability units IVs-1 dryland and IVs-6 irrigated. It is in the Saline Lowland range site and in windbreak suitability group 9N.

CrC—Creighton very fine sandy loam, 1 to 6 percent slopes. This soil is deep, very gently sloping and gently sloping, and well drained. It formed in calcareous loess and in material that weathered from fine-grained sandstone bedrock. It is on convex ridgetops and side slopes of uplands. The areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, friable very fine sandy loam about 8 inches thick. The subsurface layer is brown, friable very fine sandy loam about 9 inches thick. The subsoil is light brownish gray, friable very fine sandy loam about 8 inches thick. The underlying material is calcareous loam. It extends to a depth of more than 60 inches. It is pale brown in the upper part and light gray in the lower part. In some places, weakly cemented fine-grained sandstone is at a depth of 40 to 60 inches. In places the surface layer is thicker or lighter in color than is typical.

Included with this soil in mapping are small areas of Canyon and Keith soils. They and the Creighten soil are in similar positions on the landscape. Canyon soils are shallow. Keith soils are finer textured than the Creighton soil. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is moderately low. Tilth is good.

Most of the acreage of this soil is dry-farmed. A few small areas are in native grasses and used as rangeland.

This soil is suited to dry-farmed winter wheat and millet. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage pratices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping reduce soil blowing. Terraces can be installed to help reduce water erosion. Crop residue on the soil helps improve the organic matter content and maintain tilth and fertility.

If sprinkler irrigation is used, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Efficient management of irrigation is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control water erosion and soil blowing, and conserve moisture. Crop residue on the soil helps improve the organic matter content and helps maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees can be planted on the contour in combination with terraces to help reduce erosion and excessive runoff of water. The areas between the tree rows can be cultivated with conventional equipment. The careful use of appropriate herbicides in the rows helps control undesirable weeds and grasses. The areas around the small trees can be hoed by hand or roto-tilled. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is one way of providing it.

Septic tank absorption fields generally perform satisfactorily on this soil. Sewage lagoons need to be lined or sealed to prevent seepage, although grading is required to modify the slope and shape the lagoon. This soil is generally suitable as a site for dwellings and roads.

This soil is assigned to capability units IIIe-1 dryland and IIIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

DbB—Dailey loamy fine sand, 0 to 3 percent slopes. This soil is deep, very gently sloping, and somewhat excessively drained. It formed in thick sandy eolian sediment on concave slopes of low hummocks on uplands and stream terraces. The areas range from 10 to 180 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 7 inches thick. The subsurface layer is grayish brown, very friable loamy fine sand about 11 inches thick. A transitional layer is light brownish gray, very friable loamy fine sand about 8 inches thick. The underlying material is light gray loamy fine sand to a depth of 60 inches or more. In some places the surface layer is lighter in color than is typical.

Included with this soil in mapping are small areas of Jayem and Vetal soils. Jayem soils are well drained. They have less sand than the Dailey soil, though both soils are in similar positions. Vetal soils are well drained. They have a surface soil that is more than 20 inches thick. Vetal soils are in open and closed swales. In places, there is weakly cemented sandstone at a depth of 40 inches. The included soils make up 5 to 10 percent of the map unit.

Permeability is rapid. Runoff is slow, and the available water capacity is low. The water intake rate for sprinkler irrigation using ground water is very high, and for gravity irrigation using canal water it is moderately high. The content of organic matter is moderately low. Tilth is good.

Most of the acreage of this soil is in native grasses and is used as rangeland; however, some areas are used as irrigated or dry farmland. A few small areas are used as pasture.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil helps maintain the content of organic matter and tilth.

If sprinkler irrigation is used, this soil is suited to corn and alfalfa. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Timely irrigation is needed because of the low available water capacity of the soil. Crop residue on the soil increases the content of organic matter, improves fertility, and helps maintain tilth.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Efficient use of irrigation water and the use of fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing and in small blowouts. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding effectively reduces soil loss where the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by the use of appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows. Cultivation generally should be restricted to the tree rows. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is an efficient way to supply the needed moisture.

This soil can readily absorb the effluent from septic tank absorption fields, but it cannot filter the effluent adequately. The poor filtering capacity can result in pollution of underground water. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. This soil is generally suitable as a site for dwellings and roads.

This soil is assigned to capability units IVe-5 dryland, IVe-11 where irrigated by a sprinkler system, and IVe-8 where irrigated by a gravity system. It is in the Sandy range site and in windbreak suitability group 5.

DbD—Dailey loamy fine sand, 3 to 9 percent slopes. This soil is deep, gently sloping and strongly sloping, and somewhat excessively drained. It formed in thick sandy eolian sediment on concave slopes of hummocks on uplands and stream terraces. In some places, the slopes are convex. The areas of this soil range from 10 to 120 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 6 inches thick. The subsurface layer is brown, very friable loamy fine sand about 12 inches thick. The underlying material is light brownish gray to a depth of 60 inches or more. It is loamy sand in the upper part and fine sand in the lower part. In some places the surface layer is thinner and lighter in color than is typical.

Included with this soil in mapping are small areas of Busher, Jayem, and Vetal soils and outcrops of sandstone bedrock. Busher soils are well drained, typically have sandstone at a depth of 40 to 60 inches, and are on broad convex ridgetops. Jayem soils are well-drained, have more silt and less sand than the Dailey soil, and are in about the same kinds of positions on the landscape. Vetal soils are well drained, have a dark surface soil that is more than 20 inches thick, and are in open and closed swales and small depressions. The outcrops of sandstone are on ridgetops and sharp slope breaks. The included soils and the outcrops make up 5 to 10 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low, and the water intake rate for irrigation is very high. The content of organic matter is moderately low. Natural fertility is low. Tilth is good.

Most of the acreage of this soil is in native grasses and is used as rangeland. Some areas are farmed under irrigation.

This soil is not suited to use as dry-farmed cropland. Soil blowing and drought are very severe hazards.

If sprinkler irrigation is used, this soil is poorly suited to crops, including corn and alfalfa. Soil blowing is a very severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Irrigation is necessary because of the low available water capacity of the soil. Crop residue on the soil increases the content of organic matter, improves fertility, and helps maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing and in small blowouts. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees need to be planted in a shallow furrow or a narrow roto-tilled strip with as little disturbance of the soil as possible. Sod should be maintained between the tree rows and in the rows. The areas near the trees can be hoed by hand. Irrigation by the drip system, for example, can provide supplemental water during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not filter the effluent adequately. The poor filtering capacity can result in the pollution of ground water. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. This soil is generally suitable as a site for dwellings and roads. Reseeding native grasses as a protective cover helps reduce soil blowing on graded roadsides.

This soil is assigned to capability units VIe-5 dryland and IVe-11 irrigated. It is in the Sandy range site and in windbreak suitability group 7.

DsG—Dix loamy coarse sand, 6 to 50 percent slopes. This soil is shallow over coarse sand. It is strongly sloping to very steep and is excessively drained. It formed in gravelly and sandy material on dissected upland ridgetops and escarpments and on breaks of dissected stream terraces. The areas range from 5 to 400 acres in size.

Typically, the surface layer is brown, very friable loamy coarse sand about 8 inches thick. A transitional layer is brown, very friable gravelly loamy sand about 8 inches thick. The underlying material is coarse sand and extends to a depth of 60 inches or more. It is light brownish gray in the upper part and light gray in the lower part. In some places the surface layer is darker and thicker than is typical, and the underlying material contains more gravel. Also, in places the surface layer is gravelly loamy sand.

Included with this soil in mapping are small areas of Alice, Altvan, and Otero soils and outcrops of sandstone and siltstone bedrock. Alice soils are deep. They have less sand than the Dix soil and are in higher positions on stream terraces. Altvan soils are finer textured than the Dix soil and are moderately deep over very gravelly coarse sand. They are in higher positions on uplands. Otero soils are deep and have less sand. They are on foot slopes. The outcrops of sandstone are on narrow ridgetops and sharp slope breaks. The outcrops of siltstone are on the lower part of dissected side slopes. The included soils and the outcrops make up 10 to 15 percent of the map unit.

Permeability is very rapid. Runoff is medium. The available water capacity is very low. The content of organic matter is low. The root zone is shallow.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland. This soil is a source of sand and gravel.

This soil is not suited to use as farmland because of the excessive slope, a shallow root zone, and low fertility.

This soil is suited to use as rangeland, and this use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants on the steeper slopes.

This soil is generally not suited to trees and shrubs in windbreaks. The soil is too droughty and shallow over coarse sand.

This soil is not suited to sanitary facilities or to building site development where it is steep and very steep. It is not suited to sanitary facilities because of very rapid permeability. Suitable alternate sites should be considered for these purposes. Cuts and fills generally are needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIIs-3 dryland. It is in the Shallow to Gravel range site and in windbreak suitability group 10.

DuB—Dunday loamy fine sand, 0 to 3 percent slopes. This soil is deep, very gently sloping, and somewhat excessively drained. It formed in eolian sand on low hummocks, swales, and foot slopes in enclosed sandhill valleys. The areas range from 5 to 60 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 11 inches thick. A transitional layer is brown, very friable loamy fine sand about 6 inches thick. The underlying material is pale brown fine sand to a depth of 60 inches or more. In places the surface layer is lighter in color than is typical.

Included with this soil in mapping are small areas of Els, Hoffland, Valentine, and Wildhorse soils. Els, Hoffland, and Wildhorse soils have a high water table and are in lower positions on the landscape. Also, Wildhorse soils are strongly alkaline and very strongly alkaline. Valentine soils are excessively drained and are in higher positions on the landscape. In places, weakly cemented limy sandstone bedrock is at a depth of 40 to 60 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid. Runoff is very slow. The available water capacity is low, and the water intake rate for irrigation is very high. The content of organic matter is moderately low. Tilth is good.

This soil is in native grasses and is used as rangeland and as hayland. It is also used as irrigated farmland.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Conservation tillage and stubble mulching help keep crop residue on the surface, help control soil blowing and water erosion, and help conserve moisture. Cover crops also help. Stripcropping helps reduce soil blowing. Crop residue on the soil helps improve the organic matter content and fertility and helps maintain tilth.

If sprinkler irrigation is used, this soil is suited to corn and alfalfa. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Irrigation is needed because of the low available water capacity of the soil. Crop residue on the soil helps improve the content of organic matter, increase fertility, and maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazings can result in severe losses by soil blowing and in small blowouts. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding effectively reduces soil loss where the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by the use of appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows. Cultivation generally needs to be restricted to the tree rows. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is an effective way to supply the water.

This soil can readily absorb the effluent from septic tank absorption fields, but it cannot filter the effluent adequately. The poor filtering capacity can result in pollution of underground water. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. This soil is generally suitable for dwellings and roads.

This soil is assigned to capability units IVe-5 dryland and IIIe-11 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

DuD—Dunday loamy fine sand, 3 to 9 percent slopes. This is a deep, gently sloping and strongly sloping, somewhat excessively drained soil that formed in eolian sands. It is on hummocks and concave foot slopes in enclosed sandhill valleys. The areas range from 5 to 200 acres in size.

Typically, the surface layer and subsurface layer are grayish brown, very friable loamy fine sand about 18 inches thick. A transitional layer is brown, very friable loamy fine sand about 10 inches thick. The underlying material, to a depth of 60 inches or more, is pale brown fine sand. In places the surface layer is thinner, lighter in color, and coarser in texture than is typical.

Included with this soil in mapping are small areas of Els and Wildhorse soils and outcrops of sandstone bedrock. Els and Wildhorse soils have a high water table and are in lower positions on the landscape. Wildhorse soils are strongly alkaline. The outcrops of sandstone are on ridges and sharp slope breaks. In places there is weakly cemented limy sandstone bedrock at a depth of 40 to 60 inches. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid. Runoff is very slow. The available water capacity is low, and the water intake rate for irrigation is very high. The content of organic matter is moderately low. Tilth is good.

Most of the acreage is in native grasses and is used as rangeland or as hayland. A few small areas are irrigated for crops. Irrigation is needed because of the low available water capacity of the soil.

This soil is not suited to dry-farmed crops. Soil blowing and drought are severe hazards.

If sprinkler irrigation is used, this soil is poorly suited to crops, including corn and alfalfa. Soil blowing is a very severe hazard, although a winter cover crop helps reduce soil blowing. Conservation tillage, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue and feedlot manure on the soil help improve the organic matter content and fertility and help maintain tilth.

This soil is suited to rangeland, and this use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing and in small blowouts. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that are moderately tolerant of drought. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees need to be planted in a shallow furrow or in a roto-tilled strip with as little disturbance of the soil as possible. Sod should be maintained between the tree rows and in the rows. The areas around the trees can be hoed by hand. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil can readily absorb the effluent from septic tank absorption fields, but it cannot filter the effluent adequately. The poor filtering capacity can result in pollution of underground water. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving.

This soil is generally suited to dwellings and roads. Reseeding native grasses to provide a protective cover helps reduce soil blowing on graded roadsides.

This soil is assigned to capability units VIe-5 dryland and IVe-11 irrigated. It is in the Sandy range site and in windbreak suitability group 7.

Dw—Duroc loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It is subject to rare flooding. It formed in alluvial-colluvial sediment and loess on narrow to broad foot slopes and in open swales on stream terraces and uplands. The areas range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, friable loam about 11 inches thick. The subsurface layer is brown, friable loam about 11 inches thick. The subsoil is pale brown, friable loam about 11 inches thick. The underlying material is light brownish gray, calcareous loam to a depth of 60 inches or more. In some places the surface soil is less than 20 inches thick, and in places the surface soil and subsoil are coarser textured than is typical.

Included with this soil in mapping are small areas of soils in small depressions that are subject to ponding. The soils are stratified and are somewhat poorly drained. They make up less than 5 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high. The water intake rate for irrigation is moderate. The organic matter content is moderate. Tilth is good.

Most of the acreage of this soil is farmed. Most areas are dry-farmed, but some are irrigated. A few small areas are in native grasses and are used as rangeland.

This soil is suited to dry-farmed winter wheat and millet. The lack of precipitation is the major limitation, although, soil blowing and water erosion is a slight hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Crop residue on the soil helps improve the organic matter content and maintain tilth and fertility.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Land leveling increases the efficiency of a gravity irrigation system. A sprinkler system is an efficient method of irrigation on this soil. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil increases the organic matter content and helps maintain tilth and fertility.

This soil is suited to rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. The survival rate of adapted species is good. Weeds and grasses can be controlled by cultivating with conventional equipment between the tree rows. Hand hoeing, roto-tilling, and using appropriate herbicides in the tree rows also help. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

Septic tank absorption fields generally perform well on this soil but need protection from rare flooding. Sewage lagoons need to be lined or sealed to prevent seepage and should be diked to overcome the flooding hazard. This soil is generally not suitable for building sites because of the flooding hazard. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage from flooding and from frost action.

This soil is assigned to capability units IIc-1 dryland and I-6 irrigated. It is in the Silty range site and in windbreak suitability group 1.

DwB—Duroc loam, 1 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in alluvial-colluvial sediments and loess. It is on narrow to broad foot slopes on uplands and stream terraces. The areas range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable loam about 25 inches thick. The subsoil is pale brown, very friable loam about 8 inches thick. The underlying material is very pale brown, calcareous loam to a depth of 60 inches or more. In some places, the surface soil and underlying material are coarser textured than is typical. In some places, carbonates are leached from the soil.

Included with this soil in mapping are small areas of soils that have a surface layer of clay loam. These soils are in depressions and are subject to ponding. They make up less than 5 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is farmed. Dryfarming is common, but some areas are irrigated. A few small areas are in native grasses and are used as rangeland.

This soil is suited to dryfarmed winter wheat and millet. Water erosion and soil blowing are hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Crop residue on the soil helps increase the organic matter content and fertility and maintain tilth.

Under irrigation, this soil is suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Efficient management of irrigation water is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation is efficient on this soil. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Using a green manure crop and returning crop residue to the soil are good ways to improve tilth, the water intake rate, the organic matter content, and fertility, especially if the soil has been disturbed by land leveling.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings usually survive if competing vegetation is controlled or removed by good site preparation and by careful use of appropriate herbicides in the tree rows. Cultivating between the rows with conventional equipment helps control undesirable weeds and grasses. The areas around the small trees can be hoed by hand or roto-tilled. Trees planted on the contour help reduce erosion. Irrigation can provide supplemental water during periods of low rainfall.

Septic tank absorption fields generally perform well on this soil. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. The soil is generally suitable for building sites. Good surface drainage can reduce damage to roads and streets caused by frost action. Crowning the roads and streets by grading and constructing adequate side ditches helps provide the needed surface drainage.

This soil is assigned to capability units IIIe-1 dryland and IIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

DwC—Duroc loam, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed in alluvial-colluvial sediments and loess. It is on foot slopes of uplands and stream terraces. The areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable loam about 8 inches thick. The subsurface layer is grayish brown, very friable loam about 14 inches thick. The subsoil is pale brown, very friable loam about 8 inches thick. The underlying material is calcareous loam. It extends to a depth of more than 60 inches. It is light brownish gray in the upper part and very pale brown in the lower part. In some places the surface soil is less than 20 inches thick, and in places the surface layer and underlying material are coarser textured than is typical. In some places, carbonates are leached from the soil or are at the surface.

Permeability is moderate. Runoff is medium. The available water capacity is high. The water intake rate for irrigation is moderate. The organic matter content is moderate. Tilth is good.

Most of the acreage of this soil is in native grasses and is used as rangeland. Some areas are farmed, and most of these are dry-farmed.

This soil is suited to dry-farmed winter wheat and millet. Water erosion and snow blowing are hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Terraces can be installed to help reduce water erosion. Returning crop residue to the soil helps improve the organic matter content and maintain tilth and fertility.

Under irrigation, this soil is suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. This soil is best suited to sprinkler irrigation. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Returning crop residue to the soil helps improve the content of organic matter and helps maintain tilth and fertility.

This soil is suited to rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by careful use of appropriate herbicides in the tree rows. Cultivating between the rows with conventional equipment helps control undesirable weeds and grasses. The areas around the small trees can be hoed by hand or roto-tilled. Trees can be planted on the contour in combination with terraces to help reduce erosion and runoff. Irrigation can provide supplemental water during periods of low rainfall.

Septic tank absorption fields generally perform well on this soil. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. This soil is generally suitable for building sites. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate site ditches help provide needed surface drainage.

This soil is assigned to capability units IIIe-1 dryland and IIIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

Ef—Els fine sand, 0 to 2 percent slopes. This is a deep, nearly level, somewhat poorly drained soil that formed in eolian sand. It is on slightly concave slopes and on low, slightly hummocky slopes in enclosed sandhill valleys. It is subject to rare flooding. Typically, the areas of this soil range from 20 to 100 acres in size, but the range is 5 to 640 acres.

Typically, the surface layer is dark grayish brown, very friable fine sand about 6 inches thick. A transitional layer is grayish brown, loose fine sand about 8 inches thick. The underlying material is light brownish gray and light gray fine sand to a depth of more than 60 inches. Distinct brown mottles are common at a depth of 14 inches. In some places the surface layer is darker and thicker than is typical.

Included with this soil in mapping are small areas of Hoffland, Valentine, and Wildhorse soils and soils that are fine sandy loam. Hoffland soils are poorly drained and very poorly drained, and their position on the landscape is lower than that of the Els soil. Valentine soils are excessively drained, and they do not have a seasonally high water table. They are on dunes that are higher on the landscape. Wildhorse soils are strongly alkaline. They and the fine sandy loam soils are in positions similar to those of the Els soil. The included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low. An apparent seasonal high water table is at a depth that ranges from about 1.5 feet to about 3 feet. The water intake rate for irrigation is very high. The organic matter content is low, and tilth is fair.

Most of the acreage of this soil is in native grasses and is used for grazing and hay production. A few small areas are farmed under irrigation.

This soil is not suited to cultivated crops under dryland farming because soil blowing is a very severe hazard.

Under irrigation, this soil is poorly suited to crops, including corn and alfalfa. Sprinkler irrigation is commonly used. Wetness is a limitation, and soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage, such as disc or chisel and plant, no-till plant, and till plant, helps keep crop residue on the surface, controls soil blowing, and conserves moisture. Timely application of irrigation water is necessary because of the low available water capacity of the soil. Crop residue and feedlot manure on the soil help improve tilth and fertility and increase the content of organic matter.

This soil is suited to use as rangeland, either for grazing or haying. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet can cause small mounds to form. The mounds make grazing or harvesting hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately high seasonal water table. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation, such as planting the trees in a shallow furrow or in a narrow roto-tilled strip and disturbing the as little as possible after it has begun to dry. Areas near the trees can be hoed by hand or roto-tilled. Supplemental water, for example, from irrigation by the drip system, may be needed during periods of low rainfall to get the trees established.

This soil is not suited to sanitary facilities because of wetness and the rapid permeability. Neither is it suitable as a site for dwellings because of flooding and wetness. Alternate sites on other soils that are suited should be considered for these purposes. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help prevent damage to the roads from floods and wetness. Damage caused by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units VIe-5 dryland and IVw-12 irrigated. It is in the Subirrigated range site and in windbreak suitability group 2S.

Eh—Els loamy fine sand, 0 to 2 percent slopes. This soil is deep, nearly level, and somewhat poorly drained. It formed in wind-reworked alluvial sand on stream terraces. It is subject to rare flooding. The areas of this soil range from 5 to 150 acres in size.

Typically, the surface layer is light brownish gray, very friable loamy fine sand about 8 inches thick. The underlying material is stratified grayish brown, light brownish gray, very pale brown, pale brown, and brown loamy fine sand to a depth of more than 60 inches. Distinct mottles are common in the underlying material.

Included with this soil in mapping are small areas of Yockey, Lisco, and Valent soils and the Yockey alkali phase. These soils, except for the Valent soils which are higher on the landscape, and the Els soil are in similar positions on the landscape. Yockey soils are more silty and less sandy than the Els soil, and the Yockey alkali soil is moderately affected by alkali. Lisco soils are strongly alkaline or very strongly alkaline in the subsoil. Valent soils are excessively drained and are sandy. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is moderate. The apparent seasonal high water table is at a depth of about 1.5 feet to about 3 feet. The water intake rate for sprinkler irrigation using ground water is very high, and for gravity irrigation using canal water it is moderately high. The organic matter content is low. Tilth is fair.

Most of the acreage of this soil is farmed. The soil is used for both irrigated and dryland farming. In a few small areas the soil is in native grasses and is used as rangeland or as pasture.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a severe hazard if the surface is not adequately protected by crops or crop residue. Tillage operations and planting dates may be delayed in some years because of a seasonal high water table. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil improves tilth, the content of organic matter, and fertility.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn and alfalfa. In some years, the seasonal high water table can restrict tillage, delay planting and affect irrigation. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Returning crop residue to the soil helps improve tilth and fertility and increase the content of organic matter.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. The efficient use of water for irrigation and the application of fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to use as rangeland for either grazing or haying. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing when the the soil is wet can cause small mounds to form. The mounds make it difficult to graze or harvest for hay. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately high water table. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation, such as by planting trees in a narrow roto-tilled strip or in a shallow furrow with as little disturbance of the soil as possible. Weeds and grasses can be controlled by maintaining sod between the tree rows. The areas near the trees can be hoed by hand or roto-tilled. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil is not suited to septic tank absorption fields or building site development because of wetness. A suitable alternate site should be considered for these uses. Sewage lagoons need to be lined or sealed to prevent seepage, and they should be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the seasonal high water table. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help prevent damage to roads from flooding and wetness.

This soil is assigned to capability units IVw-5 dryland, IVw-11 where irrigated by a sprinkler system and IVw-8 where irrigated by a gravity system. It is in the Subirrigated range site and in windbreak suitability group 2S.

EkF—Epping-Keota silt loams, 3 to 30 percent slopes. This map unit consists of gently sloping to steep, well drained soils. The Epping soil is shallow. It is on knolls, dissected side slopes, low and narrow ridgetops on uplands, and in valleys. The Epping soil formed in material that weathered from siltstone. The Keota soil is moderately deep. It is on the lower part of side slopes and on foot slopes of uplands and valleys. Individual areas of this map unit range from 10 to 200 acres in size. They consist of 45 to 65 percent Epping soil and 25 to 45 percent Keota soil.

Typically, the Epping soil has a surface layer of pale brown, very friable silt loam about 3 inches thick. A transitional layer is pale brown, very friable, calcareous silt loam about 7 inches thick. The underlying material is pale brown, calcareous silt loam. Weakly cemented siltstone bedrock is at a depth of 15 inches and extends to a depth of more than 25 inches. In some places the underlying soft bedrock is sandstone.

Typically, the Keota soil has a surface layer of pale brown, very friable silt loam about 5 inches thick. A transitional layer is very pale brown, very friable silt loam about 9 inches thick. The underlying material is very pale brown, calcareous silt loam. Weakly cemented siltstone bedrock is at a depth of 34 inches and extends to a depth of more than 45 inches. In some places the underlying bedrock is sandstone.

Included with these soils in mapping are small areas of Bridget, Dix, and Mitchell soils; badland; and outcrops of siltstone and sandstone. The Bridget soils are deep, have a darker and thicker surface layer than that of the Epping and Keota soils, and are on foot slopes. Dix soils are shallow over very gravelly loamy coarse sand and are on ridgetops and breaks at higher elevations. The deep Mitchell soils are on foot slopes and alluvial fans. The areas of badland and the outcrops of siltstone and sandstone are on sharp slope breaks. The included areas make up 10 to 20 percent of the map unit.

Permeability of the Epping and Keota soils is moderate. Runoff is medium. The available water capacity is low, and the content of organic matter also is low. The root zone of the Epping soil is shallow, and that of the Keota soil is moderately deep.

Nearly all of the acreage of these soils is in native grasses and is used as rangeland.

These soils are not suited to farming because of the shallow root zone and the steep slopes.

These soils are suited to rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing can also result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants on the steeper slopes.

These soils are generally not suited to trees and shrubs in windbreaks because of the shallowness to bedrock and the steep slope. Onsite investigation is necessary to locate areas that may be suitable.

These soils generally are not suited to sanitary facilities or to building site development because of shallowness and the steep slope. A suitable alternate site should be considered for these uses. Cuts and fills generally are needed to provide a suitable grade for roads.

These soils are assigned to capability unit VIs-4 dryland. Epping soil is in the Shallow Limy range site, and Keota soil is in the Limy Upland range site. These soils are in windbreak suitability group 10.

Gn—Gering loam, alkali, 0 to 1 percent slopes. This alkali soil is moderately deep over coarse sand and gravelly coarse sand. It is somewhat poorly drained. It formed on bottom lands in loamy alluvium over sandy and gravelly alluvium and is subject to occasional flooding. The areas of this soil range from 7 to 700 acres in size.

Typically, the surface layer is grayish brown, very friable, calcareous loam about 9 inches thick. It is strongly alkaline. The subsurface layer is light brownish gray, very friable, calcareous loam about 7 inches thick. It also is strongly alkaline. The underlying material is light brownish gray calcareous loam that is very strongly alkaline. From a depth of 24 inches to a depth of more than 60 inches, there is very pale brown coarse sand and gravelly coarse sand. In some places, the texture throughout is coarser than is typical.

Included with this soil in mapping are small areas of Janise, Platte, and Yockey soils. The Janise soils are deep and in slightly higher positions on the landscape than the Gering soil. Platte soils are shallow over gravelly coarse sand and are in slightly lower positions. The Yockey soils are silty and deep. They are in positions on the landscape similar to those of the Gering soil. The included soils make up 5 to 20 percent of the map unit.

Permeability is moderate in the upper part of the soil and very rapid in the lower part. Runoff is slow. The available water capacity is low. The apparent seasonal high water table is at a depth of about 3 feet to 5 feet. The water intake rate for irrigation is moderate. The content of organic matter is moderately low, and tilth is fair. This soil has detrimental amounts of sodium and other salts.

This soil is used as irrigated farmland; the area in grasses are used as pasture, and those in native grasses are used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat. The saline-alkali condition of the soil limits its use as cropland. Soil blowing is a moderate hazard if the surface is not adequately protected by crops or crop residue. Conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing, and conserve moisture. Cover crops also help. Stripcropping helps reduce soil blowing. Returning crop residue and applying feedlot manure to the soil help improve tilth and fertility and increase the organic matter content of the soil.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The strongly alkaline surface layer and the very strongly alkaline underlying material of this soil restrict its use (fig. 8). Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Irrigation is needed because of the low available water capacity of the soil. Crop residue and feedlot manure on the soil help improve tilth, the organic matter content, and fertility.

This soil is suited to pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the

Figure 8.—Irrigated sugar beets on Gering loam, alkali, 0 to 1 percent slopes. Land-leveling cuts have exposed the very strongly alkaline underlying material (foreground).

pasture. The saline-alkali condition of this soil limits the choice of suitable plants.

This soil is suited to use as rangeland for either grazing or haying. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soils are wet can cause small mounds to form. The mounds make grazing or harvesting for hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition. The saline-alkali condition of this soil restricts it to plants that can tolerate excess salts and strongly alkaline conditions.

This soil is poorly suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately saline or alkaline condition and a moderately high water table. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Undesirable weeds and grasses can be controlled by cultivating between the tree rows with conventional equipment. The areas around the trees can be hoed by hand or roto-tilled. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is an efficient way to supply the needed moisture.

This soil is not suited to septic tank absorption fields because of flooding, wetness, and the very rapid permeability; therefore, a suitable alternate site should be considered. Sewage lagoons need to be diked to prevent damage from flooding, and the lagoons need to be lined or sealed to prevent seepage. This soil is not suitable for building site development because of flooding. Constructing roads and streets on suitable, well-compacted fill material and providing adequate side ditches and culverts help protect roads and streets from damage and wetness due to flooding.

This soil is assigned to capability units IVs-1 dryland and IVs-7 irrigated. It is in the Saline Subirrigated range site and in windbreak suitability group 9S.

Gr—Glenberg loamy fine sand, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It formed in loamy and sandy alluvium on bottom lands and is subject to occasional flooding. The areas of this soil range from 5 to 110 acres in size.

Typically, the surface layer is pale brown, very friable, calcareous loamy fine sand about 9 inches thick. The underlying material to a depth of more than 60 inches is stratified pale brown, light brownish gray, and very pale brown calcareous fine sand, very fine sandy loam, and loamy very fine sand.

Included with this soil in mapping are small areas of Bankard, Craft, and Valent soils and soils that have a seasonal high water table. Bankard soils are sandy and are somewhat excessively drained; Craft soils are silty; and Valent soils are sandy and excessively drained. Bankard and Craft soils and the Glenberg soil are in about the same positions on the landscape. Valent soils are on hummocks higher on the landscape. In wet seasons, in some places, the apparent seasonal high water table is within 1.5 feet of the surface. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate. The water intake rate for irrigation is high. The organic matter content is low. Tilth is fair.

Most of the acreage of this soil is farmed. This soil is used for both irrigated and dryland farming. In a few small areas, it is in native grasses and is used as rangeland. In other small areas it is used as pasture.

This soil is poorly suited to dry-farmed crops, including winter wheat. Flooding is a hazard. Soil blowing is a severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil improves tilth and fertility and increases the content of organic matter.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation also is efficient and is the method best suited to this soil. Flooding is a hazard; soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop or feedlot manure and crop residue on the soil surface improve tilth, the infiltration of water, the organic matter content, and fertility, especially if the soil has been disturbed by land leveling.

This soil is suited to use as irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Efficient use of irrigation water and application of fertilizer according to soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture grasses.

This soil is suited to use as rangeland, and this use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed. This can be accomplished by good site preparation and by using appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows. Cultivation generally needs to be restricted to the tree rows. Supplemental water, for example, from irrigation by the drip system, may be needed during periods of low rainfall.

This soil is not suited to septic tank absorption fields because of flooding and seepage. Sewage lagoons need to be diked as a protection from flooding, and they need to be lined or sealed to prevent seepage. This soil is not suited to use as building sites because of flooding. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help prevent flood damage to the road.

This soil is assigned to capability units IVw-5 dryland and IIIw-10 irrigated. It is in the Sandy Lowland range site and in windbreak suitability group 5.

Gs—Glenberg very fine sandy loam, 0 to 2 percent slopes. This soil is deep, nearly level, and well drained. It formed in loamy and sandy alluvium on bottom lands and is subject to occasional flooding. The areas of this soil range from 5 to 150 acres in size.

Typically, the surface layer is light brownish gray, very friable, calcareous very fine sandy loam about 8 inches thick. The underlying material to a depth of more than 60 inches is stratified light brownish gray and light gray, calcareous very fine sandy loam, loamy fine sand, loamy sand, fine sandy loam, and fine sand.

Included with this soil in mapping are small areas of Bankard and Craft soils and soils with a seasonal high water table. The Bankard soils are somewhat excessively drained and are sandy. The Craft soils are silty. The Bankard and Craft soils are in positions on the landscape similar to those of the Glenberg soil. In some places the apparent seasonal high water table is within 1.5 feet of the surface in wet seasons. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate, and the water intake rate for irrigation is moderately high. The content of organic matter is low. Tilth is good.

Most of the acreage of this soil is farmed. The soil is used for both irrigated and dryland farming. A few small areas in native grasses are used as rangeland, and other small areas are used as pasture.

This soil is suited to dry-farmed winter wheat. Flooding is a hazard. Soil blowing is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil increases the content of organic matter and fertility and helps maintain tilth.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Flooding is a hazard. Land leveling increases the efficiency of a gravity irrigation system. The sprinkler method can be used to increase the efficiency of irrigation. Soil blowing is a slight hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the infiltration of water, and the organic matter content, especially if the soil has been disturbed by land leveling

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Efficient use of irrigation water and the use of fertilizer in amounts based on soil tests are concerns in management. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and the use of appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally needs to be restricted to the tree rows. Irrigation by the drip system is an efficient way to supply moisture to the soil during periods of low rainfall.

This soil is not suited to septic tank absorption fields or building site development because of flooding. A suitable alternate site should be considered for these uses. Sewage lagoons need to be diked to prevent damage from flooding, and the lagoons need to be lined or sealed to prevent seepage. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from flooding.

This soil is assigned to capability units IIIw-3 dryland and IIw-8 irrigated. It is in the Sandy Lowland range site and in windbreak suitability group 5.

Gt—Gothenburg loamy sand, 0 to 2 percent slopes. This soil is shallow and very shallow over gravelly coarse sand. It is nearly level and somewhat poorly drained. It formed on bottom lands in sandy alluvium over sandy and gravelly material. It is subject to frequent flooding, especially when ice jams occur in the North Platte River channels. The areas of this soil are commonly dissected by old, shallow, abandoned stream channels and range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, friable, calcareous loamy sand about 3 inches thick. The underlying material is stratified light gray and light brownish gray, calcareous fine sand, coarse sand, and loamy fine sand. Between a depth of about 20 inches and a depth of more than 60 inches, there is light gray, gravelly coarse sand. In some places the surface layer is lighter in color than is typical.

Included with this soil in mapping are small areas of Barney and Platte soils and deposits of recent sand and gravel. The poorly drained Barney soil has a thicker surface layer than that of the Gothenburg soil and is at lower elevations. Platte soils have a thicker surface layer and are at higher elevations. Deposits of recent sand and gravel are in slightly higher positions. Also, in places, there are shallow water areas. The inclusions make up 5 to 15 percent of the map unit.

Permeability is very rapid, and runoff is slow. The available water capacity is very low. The apparent seasonal high water table is at the surface or within about 2 feet of the surface. The content of organic matter is low. The root zone is shallow or very shallow.

Nearly all of the acreage of this soil has been invaded by shrubs and trees.

This soil is not suited to use as farmland because of its shallow root zone, wetness caused by the seasonal high water table, and flooding.

This soil is poorly suited to rangeland because it has a shallow root zone and is subject to frequent flooding.

This soil is generally not suited to trees and shrubs in windbreaks because the root zone is too shallow and the soil is too wet.

This soil is suited to wetland plants that provide food and cover for wetland wildlife.

This soil is not suited to sanitary facilities nor to building-site development because of flooding and wetness; therefore, a suitable alternate site should be considered for these uses. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from flooding and wetness.

This soil is assigned to capability unit VIIs-3 dryland. It is in windbreak suitability group 10. It was not assigned to a range site.

Hf—Hoffland fine sandy loam, 0 to 1 percent slopes. This soil is deep, nearly level, and poorly drained. It formed in sandy eolian materials and alluvial sediment in valleys of sandhills. It is subject to occasional flooding. The areas of this soil range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, very friable, calcareous fine sandy loam about 8 inches thick. A transitional layer is light brownish gray, loose, calcareous fine sand about 5 inches thick. The underlying material, to a depth of 60 inches or more, is very pale brown fine sand. In some places the surface layer is thicker and coarser in texture than is typical. Also, in places the underlying material contains more silt and less sand.

Included with this soil in mapping are small areas of Dunday, Marlake, Valentine, and Wildhorse soils. Dunday soils are somewhat excessively drained and are at higher elevations than the Hoffland soil. Marlake soils are very poorly drained, typically have water on the surface for most of the year, and are lower on the landscape. Valentine soils are excessively drained, do not have a high water table, and are at higher elevations. Wildhorse soils are strongly alkaline and are in positions similar to those of the Hoffland soil. The included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low. The apparent seasonal high water table is at the surface or within a depth of about 1.5 feet. The content of organic matter is moderate.

Nearly all of the acreage of this soil is in native grasses and is used for hay or as rangeland.

This soil is not suited to use as cropland because of wetness caused by the seasonal high water table. In most places it is not practical to overcome this limitation.

This soil is suited to use as rangeland either for grazing or for hay (fig. 9). Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet can cause small mounds to form. The mounds make grazing or harvesting hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition.

This soil is generally limited to a few species of trees and shrubs in windbreaks because of the seasonal high water table.

This soil is not suited to septic tank absorption fields or to building site development because of flooding and wetness. A suitable alternate site should be considered. Sewage lagoons need to be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the seasonal high water table, and the lagoons need to be lined or sealed to prevent seepage. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from flooding and wetness.

Figure 9.—Rangeland and hayland in an area of Hoffland fine sandy loam, 0 to 1 percent slopes.

This soil is assigned to capability unit Vw-7. It is in the Wet Subirrigated range site and in windbreak suitability group 2D.

Hg—Hoffland fine sandy loam, wet, 0 to 1 percent slopes. This soil is deep, nearly level, and very poorly drained. It formed in sandy eolian material and alluvial sediment in valleys of the sandhills. It is subject to ponding of surface water. The areas of this soil range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable, calcareous fine sandy loam about 8 inches thick. The underlying material extends to a depth of 60 inches or more. It is pale brown fine sand in the upper part, light gray fine sand in the middle part, and dark gray loamy fine sand and gray fine sand in the lower part. In some places the surface layer is thinner than is typical. Also, in places the surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of Dunday, Els, and Marlake soils. Dunday soils are somewhat excessively drained. They do not have a high water table and are higher on the landscape than the Hoffland soil. Els soils are somewhat poorly drained and are slightly higher on the landscape. Marlake soils have water on the surface for most of the year and are in slightly lower positions on the landscape. The included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is ponded. The available water capacity is low. The apparent seasonal high water table is about 0.5 foot above the surface or within a depth of about 1 foot. The organic matter content is moderate.

Nearly all of the acreage of this soil is in native grasses and is used as hayland.

This soil is not suited to use as farmland because of wetness, which is caused by the high water table and ponding.

This soil is suited to use as rangeland and hayland. Haying at an improper time and mowing to an improper height reduce the protective cover and cause the native plants to deteriorate.

This soil is generally not suited to trees and shrubs in windbreaks because of the seasonal high water table and the ponding of surface water.

This soil is suited to plants that provide food and cover for wetland wildlife.

This soil is not suited to sanitary facilities or to building site development because of the ponding of surface water and the seasonal high water table. A suitable alternate site should be considered. Constructing roads on suitable, well-compacted fill material above the ponding level and providing adequate side ditches and culverts help prevent damage to roads from wetness.

This soil is assigned to capability unit Vw-7. It is in the Wet Land range site and in windbreak suitability group 10.

Ja—Janise loam, 0 to 1 percent slopes. This saline-alkali soil is deep, nearly level, and somewhat poorly drained. This soil formed in mixed loamy calcareous alluvium on broad bottom lands. It is subject to occasional flooding. The areas of this soil range from 5 acres to 640 acres or more in size.

Typically, the surface layer is light brownish gray, very friable loam about 2 inches thick. The subsurface layer is gray, very friable, calcareous loam about 2 inches thick. The subsoil is friable loam about 20 inches thick and is light brownish gray in the upper part and light gray in the lower part. The underlying material extends to a depth of about 60 inches. It is white loam in the upper part, pale brown loamy fine sand in the middle part, and very pale brown and brown coarse sand in the lower part. In some places the subsoil is finer textured and has thin strata of silty clay and clay. Also, in places the subsoil is fine sandy loam, sandy loam, or loamy very fine sand. In places the surface layer is darker and thicker than is typical.

Included with this soil in mapping are small areas of Yockey soils and the Yockey alkali phase. Yockey soils are not so strongly affected by saline-alkali conditions as the Janise soil, although the soils are in about the same kind of position on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately slow. Runoff is slow. The available water capacity is moderate. The apparent seasonal high water table is at a depth of about 2 feet to about 3 feet. The content of organic matter is low. Reaction is strongly alkaline in the surface layer and very strongly alkaline in the subsoil. This soil contains detrimental amounts of sodium and other salts.

Most of the acreage of this soil is in native grasses and is uses as rangeland and hayland. A few small areas are used as pasture.

This soil is not suited to use as farmland because it is strongly affected by alkali characteristics. It is not practical to overcome or avoid this limitation under a system of cultivation.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. The efficient use of water for irrigation and the application of fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture. The saline-alkali characteristics of the soil restrict it to plants that are tolerant of excess salts and of strongly alkaline and very strongly alkaline conditions.

This soil is suited to use as rangeland for either grazing or hay. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition. The saline-alkali characteristics of the soil restrict it to native plants that are tolerant of excess salts and strongly alkaline and very strongly alkaline conditions.

This soil is not suited to trees and shrubs in windbreaks because it is strongly alkaline.

This soil is not suited to sanitary facilities or to building-site development because of flooding and wetness. A suitable alternate site should be considered for these uses. Constructing roads and streets on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads and streets from flooding and wetness. Good surface drainage and a gravel moisture barrier in the subgrade can reduce damage to roads and streets caused by frost action. Crowning the roads and streets by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability unit VIs-1 dryland. It is in the Saline Subirrigated range site and in windbreak suitability group 10.

JmB—Jayem loamy fine sand, 0 to 3 percent slopes. This is a deep, very gently sloping, well drained soil on uplands. This soil formed in loamy material that weathered from sandstone bedrock and in eolian sediment. The areas of this soil range from 5 to 100 areas in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 10 inches thick. The subsoil is very friable and about 13 inches thick. It is grayish brown fine sandy loam in the upper part and pale brown very fine sandy loam in the lower part. The underlying material is very pale brown loamy very fine sand to a depth of 60 inches or more. In some places the surface layer is lighter in color and the subsoil is finer textured than is typical.

Included with this soil in mapping are small areas of Busher, Dailey, and Vetal soils. Busher soils have soft, weakly cemented sandstone bedrock at a depth of 40 to

60 inches. They are in slightly higher positions on the landscape than the Jayem soils. Dailey soils have more sand in the subsoil and are in positions similar to those of the Jayem soil. Vetal soils have a dark surface layer that is more than 20 inches thick and are in open swales. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate. The water intake rate for irrigation is high. The content of organic matter is moderately low and tilth is good.

Most of the acreage of this soil is used as irrigated or nonirrigated farmland. A few small areas are in native grasses and are used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Cover crops also help. Stripcropping helps reduce soil blowing. Returning crop residue to the soil helps increase the organic matter content and fertility and helps maintain tilth.

If irrigated by the sprinkler system, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps increase the organic matter content and fertility and helps maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by using appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally needs to be restricted to the tree rows. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil is generally suited to septic tank absorption fields. It is suitable for dwellings and roads. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-5 dryland and IIIe-10 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

JmC—Jayem loamy fine sand, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed on uplands and stream terraces in loamy material that weathered from sandstone bedrock and eolian sediment. The areas of this soil range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 14 inches thick. The subsoil is very friable fine sandy loam about 20 inches thick. It is grayish brown in the upper part and brown in the lower part. The underlying material, to a depth of 60 inches or more, is very pale brown loamy sand. In some places the surface layer is lighter in color than is typical.

Included with this soil in mapping are small areas of Dailey, Valent, and Vetal soils. Dailey soils have more sand in the subsoil than the Jayem soil and are in about the same positions on the landscape. Valent soils are sandy, lighter in color, and in positions on the landscape similar to those of the Jayem soil. Vetal soils have a surface layer that is more than 20 inches thick and are in lower positions on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate, and the water intake rate for irrigation is high. The content of organic matter is moderately low. Tilth is good.

Most of the acreage of this soil is used as irrigated or nonirrigated farmland. A few small areas are in native grasses and are used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil helps increase the content of organic matter and fertility and helps maintain tilth.

Under irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Sprinkler irrigation is the most efficient system for this soil. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and hconserve moisture. Crop residue on the soil helps increase the content of organic matter and fertility and helps maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding effectively reduces soil loss if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well and can grow in sandy soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and the use of selected, appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally needs to be restricted to the tree rows. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil is generally suited to septic tank absorption fields, and it is suitable for dwellings and roads. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-5 dryland and IVe-10 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

JnB—Jayem fine sandy loam, 0 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in loamy material that weathered from sandstone bedrock and eolian sediment on uplands and stream terraces. The areas of this soil range from 3 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 11 inches thick. The subsoil is brown, firm fine sandy loam about 9 inches thick. The underlying material, to a depth of 60 inches or more, is light brownish gray fine sandy loam. In some places the surface layer is more than 20 inches thick. Also, in places the surface layer is lighter in color and less than 7 inches thick. In some places the subsoil has more clay than is typical. In other places the subsoil has free carbonates, and there is a layer of accumulated lime in the upper part of the underlying material.

Included with this soil in mapping are small areas of Busher, Dailey, and Oglala soils. Busher and Oglala soils have weakly cemented sandstone bedrock at a depth of 40 to 60 inches. Busher soils are on uplands in positions similar to those of the Jayem soil. Oglala soils are on uplands but in slightly lower positions on the landscape. Dailey soils have more sand than the Jayem soil and are in similar positions. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate. The water intake rate for irrigation is moderately high. The organic matter content is moderate, and tilth is good.

Most of the acreage of this soil is used as irrigated or nonirrigated farmland. A few small areas are in native grasses and are used as rangeland.

This soil is suited to dry-farmed winter wheat and millet (fig. 10). Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil helps increase the content of organic matter and helps maintain tilth and fertility.

Under irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. A sprinkler system is the most efficient system of irrigation for this soil. Soil blowing is only a slight hazard. A winter cover crop can minimize the hazard. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth and the water intake rate and increase the content of organic matter and fertility, especially if the soil has been disturbed by land leveling operations.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by the use of appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows. Cultivation generally needs to be restricted to the tree rows. Irrigation by the drip system is an efficient way to provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields. It is also suitable for dwellings and roads. Sewage lagoons need to be lined or sealed to prevent seepage.

Figure 10.—Wheat-fallow in an area of Jayem fine sandy loam, 0 to 3 percent slopes.

The walls or sides of shallow excavations can be shored to prevent sloughing or caving.

This soil is assigned to capability units IIIe-3 dryland and IIe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

JnC—Jayem fine sandy loam, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed in loamy material that weathered from sandstone bedrock and eolian sediment. It is on convex ridgetops, side slopes of uplands, and on stream terraces. The areas range from 5 to 160 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 13 inches thick. The subsoil is brown, very friable fine sandy loam about 12 inches thick. The underlying material extends to a depth of more than 60 inches. It is light brownish gray fine sandy loam in the upper part and pale brown loamy very fine sand in the lower part. In some places the dark surface soil is more than 20 inches thick. Also, in places the surface layer is lighter in color and thinner than is typical. In some places the subsoil has more clay than is typical. In other places the subsoil has free carbonates, and there is a layer of accumulated lime in the upper part of the underlying material.

Included with this soil in mapping are small areas of Busher, Dailey, and Oglala soils. Busher and Oglala soils have weakly cemented sandstone bedrock at a depth of 40 to 60 inches. Busher soils are on uplands. They and the Jayem soil are in about the same positions on the landscape. Dailey soils have more sand than the Jayem soil. Dailey soils and the Jayem soil are in similar positions on the landscape. Oglala soils are slightly lower on the landscape on uplands. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate. The water intake rate for irrigation is moderately high. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is used as irrigated or nonirrigated farmland. A few small areas are used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Terraces can be installed to help reduce water erosion. Returning crop residue to the soil helps increase the content of organic matter and helps maintain tilth and fertility.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. Soil blowing is a moderate hazard, but a winter cover crop reduces the hazard. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the infiltration of water, the content of organic matter, and fertility, especially if this soil has been disturbed by land leveling operations.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by using appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally needs to be restricted to the tree rows. Trees can be planted on the contour in combination with terraces to help reduce erosion and excessive runoff. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil is generally suited to septic tank absorption fields. It is also suitable for dwellings and roads. Sewage lagoons need to be lined or sealed to prevent seepage.

This soil is assigned to capability units IVe-3 dryland and IIIe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

JnD—Jayem fine sandy loam, 6 to 9 percent slopes. This soil is deep, strongly sloping, and well drained. It formed in loamy material that weathered from sandstone bedrock and eolian sediment. It is on convex side slopes and narrow ridgetops of uplands and stream terraces. The areas range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 10 inches thick. The subsoil is grayish brown, friable very fine sandy loam about 7 inches thick. The underlying material is very fine sandy loam. It is light brownish gray in the upper part and light gray in the lower part. In some places the subsoil contains more clay. Also, in places the subsoil contains free carbonates, and there is a layer of accumulated lime in the upper part of the underlying material. In some places the surface layer is lighter in color and thinner than is typical.

Included with this soil in mapping are small areas of Busher and Dailey soils. Busher soils have weakly cemented sandstone bedrock at a depth of 40 to 60 inches. Busher soils are on uplands; they and the Jayem soil are in similar positions on the landscape. Dailey soils have more sand than the Jayem soil, and they too are in similar positions on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate, and the water intake rate for irrigation is moderately high. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is used as irrigated or nonirrigated farmland. Some areas are in native grasses and are used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Terraces can be installed to help reduce water erosion. Crop residue on the soil helps increase the content of organic matter and helps maintain tilth and fertility.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Managing irrigation water efficiently is a concern because of the strong slope. Soil blowing is a serious hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps increase the organic matter content and helps maintain tilth and fertility.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by using selected, appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally needs to be restricted to the tree rows. Trees can be planted on the contour in combination with terraces to help reduce erosion and excessive runoff. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil is generally suited to septic tank absorption fields. It is also suitable as a site for dwellings and roads. Sewage lagoons need to be lined or sealed to prevent seepage. Grading is necessary to modify the slope and shape the lagoon.

This soil is assigned to capability units IVe-3 dryland and IVe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 7.

JnE—Jayem fine sandy loam, 9 to 20 percent slopes. This soil is deep, moderately steep, and well drained. It formed in loamy material that weathered from sandstone bedrock and eolian sediment on convex side slopes on uplands and stream terraces. The areas range from 5 to 80 acres.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 7 inches thick. The subsoil is brown, very friable very fine sandy loam about 15 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown loamy very fine sand in the upper part and very pale brown loamy fine sand in the lower part. In some places the subsoil has more clay than is typical. Also, in places the subsoil has free carbonates, and there is a layer of accumulated lime in the upper part of the underlying material. In some places the surface layer is lighter in color and thinner than is typical.

Included with this soil in mapping are small areas of Busher and Dailey soils. Busher soils have weakly cemented sandstone bedrock at a depth of 40 to 60 inches. Busher soils are on uplands on about the same kind of landscape as the Jayem soil. Dailey soils have more sand than the Jayem soil. They and the Jayem soil are in similar positions on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate. The content of organic matter is moderate.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland.

This soil is not suited to use as farmland because of the moderately steep slopes and the very severe water erosion hazard.

The use of this soil as rangeland effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by using selected, appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally needs to be restricted to the tree rows. Trees planted on the contour reduce erosion and excessive runoff. Irrigation, by the drip system, can provide supplemental water during periods of low rainfall.

Land shaping and installing a septic tank absorption field on the contour generally are necessary for proper operation. This soil is not suited to sewage lagoons because of seepage and the moderately steep slopes. A suitable alternate site should be considered. Dwellings need to be designed to accommodate the slope, or the soil needs to be graded to an acceptable gradient. Cuts and fills are generally needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-3 dryland. It is in the Sandy range site and in windbreak suitability group 7.

Ke—Keith loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It formed in loess on slightly convex slopes on broad upland divides. The areas range from 10 to 440 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsurface layer is dark grayish brown friable loam about 7 inches thick. The subsoil is friable silt loam about 18 inches thick. It is grayish brown in the upper part and light brownish gray in the middle part and the lower part. The underlying material is very pale brown, calcareous loam to a depth of more than 60 inches. There is a layer of accumulated lime in the upper part. In some places the dark surface soil is more than 20 inches thick and the subsoil is less clayey. Also, in places the lower part of the underlying material is fine sand or loamy sand or is strongly alkaline. There is gravel on the surface in some places.

Included with this soil in mapping are small areas of soils that are subject to ponding. These soils have a dark surface soil that is more than 20 inches thick. They are in depressions, in long open swales, and in drainageways. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high. The water intake rate for irrigation is moderately low. The content of organic matter is moderate, and tilth is good.

Nearly all of the acreage of this soil is dry-farmed; some areas are irrigated.

This soil is suited to dry-farmed winter wheat and millet. The lack of precipitation is the major limitation, although water erosion and soil blowing are hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Crop residue on the soil helps increase the water intake rate and the content of organic matter and helps maintain tilth and fertility.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Land leveling increases the efficiency of a gravity irrigation system. A sprinkler irrigation system is efficient on this soil. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps increase the infiltration of water and the content of organic matter and helps maintain tilth and fertility.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by the careful use of appropriate herbicides in the tree rows. Conventional cultivating equipment can be used to control undesirable weeds and grasses between the tree rows. The areas in the tree rows or near small trees can be hoed by hand or roto-tilled. Irrigation by the drip system can provide supplemental water during periods of low rainfall.

This soil is suited to septic tank absorption fields and to sites for dwellings with basements. Sewage lagoons need to be lined or sealed to prevent seepage. Foundations for buildings and dwellings without basements need to be strengthened and backfilled with coarse material to prevent damage caused by the shrinking and swelling of the soil. It is necessary to design roads so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. Using coarser grained material for subgrade or base material can also help.

This soil is assigned to capability units IIc-1 dryland and I-4 irrigated. It is in the Silty range site and in windbreak suitability group 3.

KeB—Keith loam, 1 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in loess and is on convex slopes on broad upland divides and side slopes. The areas of this soil range from 10 to 400 acres.

Typically, the surface layer is grayish brown, friable loam about 6 inches thick. The subsurface layer is grayish brown, friable silt loam about 5 inches thick. The subsoil is friable silt loam about 19 inches thick. It is grayish brown in the upper part and light brownish gray in the middle part and in the lower part. To a depth of 60 inches or more, the underlying material is very pale brown, calcareous silt loam. A layer of accumulated lime is in the upper part. In some places the surface layer and subsurface layer combined are more than 20 inches thick, and the subsoil contains less clay. Also, in places the depth to carbonates is more than 40 inches. In some places the surface layer and the subsurface layer combined is less than 8 inches thick because of erosion.

Included with this soil in mapping are areas of rock outcrop and small areas of shallow and moderately deep soils that have concentrations of sandstone fragments on the surface. The rock outcrop consists of fragments of limy sandstone. The included areas are on small knolls and on shoulders of side slopes. A few small areas are on stream terraces. The included areas make up less than 5 percent of the map unit.

Permeability is moderate, and runoff is slow. The available water capacity is high. The water intake rate for irrigation is moderately low. The content of organic matter is moderate, and tilth is good.

Most of the acreage of this soil is dry-farmed; some areas are irrigated. A few small areas are used as rangeland.

This soil is suited to dry-farmed winter wheat and millet. Water erosion and soil blowing are hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Returning crop residue to the soil helps improve the infiltration of water, increase the content of organic matter, and maintain tilth and fertility.

Under irrigation, this soil is suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of the slope. Land leveling increases the efficiency of a gravity irrigation system. A sprinkler system however, is the most efficient irrigation system for this soil. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, fertility, and the infiltration of water, and increase the content of organic matter, especially if the soil has been disturbed by land leveling.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and the careful use of appropriate herbicides in the tree rows. Conventional equipment can be used to control undesirable weeds and grasses between the tree rows.

The areas around the small trees can be hoed by hand or roto-tilled. Trees planted on the contour help reduce erosion and control runoff. Irrigation, by the drip system, can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and to sites for dwellings with basements. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. Foundations for buildings and dwellings without basements need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. It is necessary also to design roads so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. The use of a coarser-grained material for subgrade or base material also helps.

This soil is assigned to capability units IIe-1 dryland and IIe-4 irrigated. It is in the Silty range site and in windbreak suitability group 3.

KeC—Keith loam, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed in loess and is on convex slopes on uplands. The areas of this soil range from 5 to 160 acres.

Typically, the surface layer is grayish brown, friable loam about 9 inches thick. The subsoil is friable and about 18 inches thick. It is grayish brown silty clay loam in the upper part, pale brown silty clay loam in the middle part, and pale brown, calcareous silt loam in the lower part. There is an accumulation of lime in the lower part. The underlying material is very pale brown, calcareous silt loam to a depth of more than 60 inches. In some places the surface layer is pale brown and about 5 inches thick. Also, in places the lower part of the underlying material is sand.

Included with this soil in mapping are small areas of shallow and moderately deep soils that have concentrations of sandstone fragments on the surface. Also included are areas of rock outcrop. Typically, the rock outcrop consists of fragments of limy sandstone. The included areas are on small knolls and side slopes. A few small areas are on stream terraces. The included areas make up about 1 to 5 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderately low. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is dry-farmed, although some soils are irrigated. Some areas are in native grasses and used as rangeland.

This soil is suited to dry-farmed winter wheat and millet. Water erosion is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Terraces can be installed to help reduce water erosion. Returning crop residue to the soil helps improve the infiltration of water, increase the content of organic matter, and maintain tilth and fertility.

Under sprinkler irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps improve the infiltration of water, increase the content of organic matter, and maintain tilth and fertility.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by the careful use of appropriate herbicides in the tree rows. Conventional equipment can be used to cultivate between the tree rows to control undesirable weeds and grasses. The areas around small trees can be hoed by hand or roto-tilled. Trees can be planted on the contour in combination with terraces to help reduce erosion and control runoff. Irrigation, by the drip system, can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and to sites for dwellings with basements. Sewage lagoons need to be lined or sealed to prevent seepage and grading is necessary to modify the slope and shape the lagoon. Foundations for buildings and dwellings without basements need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. It is necessary to design roads so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. Using a coarser grained material for subgrade or base material also helps.

This soil is assigned to capability units IIIe-1 dryland and IIIe-4 irrigated. It is in the Silty range site and in windbreak suitability group 3.

KeC2—Keith loam, 3 to 6 percent slopes, eroded. This soil is deep, gently sloping, and well drained. It formed in loess. It is on convex slopes and side slopes on uplands. In places the slopes are dissected. The areas of this soil range from 5 to 160 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 6 inches thick. In places tillage has mixed the upper part of the subsoil with the surface layer. The subsoil is about 19 inches thick. It is brown, very friable loam in the upper and middle parts and pale brown, very friable, calcareous loam in the lower part, where lime has accumulated. To a depth of more than 60 inches, the underlying material is calcareous loam. It is light gray in the upper part, where lime has accumulated, and very pale brown in the lower part. In some places the surface layer is thicker than is typical. Also, in places the subsoil is coarser textured. In places, gravel is on the surface, and in other places, weakly cemented, limy sandstone bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Altvan soils and soils that are calcareous at the surface. Altvan soils have very gravelly coarse sand at a depth of 20 to 40 inches. They and the Keith soil are in similar positions on the landscape. The calcareous soils are lighter in color and finer in texture than the Keith soil. They are on small knobs and side slopes where erosion has removed the original surface layer and the upper part of the subsoil. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderately low. The content of organic matter is also moderately low. Tilth is good.

Most of the acreage of this soil is dry-farmed, although some areas are irrigated, and some areas have been seeded back to native grasses.

This soil is suited to dry-farmed winter wheat and millet. Water erosion is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Terraces can be installed to help reduce water erosion. Returning crop residue to the soil helps improve the infiltration of water, increase the content of organic matter and fertility, and maintain tilth.

Under sprinkler irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps improve the infiltration of water, increase the content of organic matter and fertility, and maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding where cropland is eroded may be needed to stabilize the soil.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by the careful use of appropriate herbicides in the tree rows. Conventional equipment can be used to cultivate between the tree rows to control undesirable weeds and grasses. The areas around small trees can be hoed by hand or roto-tilled. Trees can be planted on the contour in combination with terraces to help reduce erosion and control runoff. Irrigation, by the drip system, can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields, and it is suitable as a site for dwellings with basements. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. Foundations for buildings and dwellings without basements need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. It is necessary to design roads so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. Using a coarser grained material for subgrade or base material also helps.

This soil is assigned to capability units IIIe-8 dryland and IIIe-4 irrigated. It is in the Silty range site and in windbreak suitability group 3.

KeD2—Keith loam, 6 to 9 percent slopes, eroded. This soil is deep, strongly sloping, and well drained. It formed in loess. It is on convex slopes, ridgetops, and side slopes on uplands. The areas of this soil range from 5 to 80 acres.

Typically, the surface layer is grayish brown, friable loam. Erosion has thinned the surface layer to about 6 inches. In places tillage has mixed the upper part of the subsoil with the remaining surface layer. The subsoil is pale brown, friable loam about 10 inches thick. The underlying material is very pale brown, calcareous loam to a depth of more than 60 inches. In some places the surface layer is thicker and darker in color than is typical. In places the subsoil is thicker and is grayish brown in the upper part. In places the subsoil is finer textured than is typical. In some places, limy sandstone bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of soils that are calcareous at the surface, fragments of sandstone, and rock outcrop. The calcareous soils are lighter in color than the Keith soil. They are on narrow ridgetops where erosion has removed the original surface layer and the upper part of the subsoil. Typically, the fragments of limy sandstone and the rock outcrop are on small knolls and side slopes. The included areas make up 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is rapid. The available water capacity is high. The water intake rate for irrigation is moderately low. The content of organic matter is moderately low, and tilth is good.

Most of the acreage of this soil is dry-farmed, but some areas are irrigated. Some areas have been seeded back to native grasses.

This soil is poorly suited to dry-farmed crops, including winter wheat and millet. Water erosion is a severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Terraces can be installed to help reduce water erosion. Crop residue on the soil helps improve the infiltration of water, increase the content of organic matter and fertility, and maintain tilth.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Returning crop residue to the soil helps improve the infiltration of water, increase the organic matter content and fertility, and maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding where cropland is eroded may be needed to stabilize the soil.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by using appropriate herbicides in the tree rows. Conventional equipment can be used to cultivate between the tree rows to help control undesirable weeds and grasses. The areas around small trees can be hoed by hand or roto-tilled. Trees can be planted on the contour in combination with terraces to help reduce erosion and control runoff. Irrigation can provide supplemental water during periods of low rainfall. The drip system is an efficient method to use.

Land shaping and installing the septic tank absorption field on the contour generally are necessary if the field is to function properly. Sewage lagoons need to be lined or sealed to prevent seepage, and extensive grading is necessary to modify the slope and shape the lagoon. This soil is generally suitable as sites for dwellings with basements. Foundations for buildings and dwellings without basements need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. It is necessary to design roads so that the surface pavement and subbase are thick enough to compensate for the low strength of the soil material. The use of a coarser grained material for subgrade or base material also helps.

This soil is assigned to capability units IVe-8 dryland and IVe-4 irrigated. It is in the Silty range site and in windbreak suitability group 3.

Ls—Lisco very fine sandy loam, 0 to 2 percent slopes. This saline-alkali soil is deep, nearly level, and somewhat poorly drained. It formed in loamy calcareous alluvium on bottom lands and is subject to occasional flooding. The areas of this soil range from 5 to 820 acres.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 2 inches thick. The subsurface layer is light brownish gray, very friable very fine sandy loam about 2 inches thick. The subsoil is light brownish gray, calcareous loam about 18 inches thick. Reaction is very strongly alkaline. The subsoil is friable very fine sandy loam in the upper part and very friable fine sandy loam in the lower part. The underlying material, which extends to a depth of 60 inches or more, is light gray fine sandy loam in the upper part and very pale brown loamy fine sand in the lower part. It is very strongly alkaline in the upper part and strongly alkaline in the lower part. In some places the subsoil has more clay and the profile is finer textured than is typical.

Included with this soil are small areas of Wildhorse and Yockey alkali soils. The sandy Wildhorse soils are lower on the landscape than the Lisco soil. The Yockey alkali soils contain more silt and less sand, and they also are lower on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate. The apparent seasonal high water table is at a depth of about 1.5 feet to a depth of about 3.5 feet. The content of organic matter is moderately low. This soil contains detrimental amounts of sodium and other salts.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland and hayland. A few small areas are used as pasture.

This soil is not suited to use as farmland because of its high salinity and alkalinity. These limitations generally are not practical to overcome.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Efficient use of irrigation water and use of fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture. The saline-alkali characteristic of this soil severely restricts it to plants that can tolerate excess salts and strongly alkaline or very strongly alkaline conditions.

This soil is suited to use as rangeland for either grazing or haying. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet can cause small mounds to form. The mounds make grazing or harvesting for hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition. The saline-alkali characteristic of this soil severely restricts it to native plants that can tolerate excess salts and strongly alkaline or very strongly alkaline conditions.

This soil is generally not suited to trees and shrubs in windbreaks. The soil is too saline or alkaline.

This soil is not suited to septic tank absorption fields or to building site development because of flooding. Suitable alternate sites should be considered for these purposes. Sewage lagoons need to be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the seasonal high water table and then lined to prevent seepage. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from flooding and wetness.

This soil is assigned to capability unit VIs-1 dryland. It is in the Saline Subirrigated range site and in windbreak suitability group 10.

Ma—Marlake fine sandy loam, 0 to 1 percent slopes. This soil is deep, nearly level, and very poorly drained. It formed in eolian sand and sandy and loamy alluvium in depressions in sandhill valleys and in depressions bordering lakes and streams. It is subject to ponding. The areas of this soil range from 5 to 150 acres.

Typically, the surface layer is gray, very friable fine sandy loam about 9 inches thick. A transitional layer is stratified light brownish gray, very friable loamy fine sand and fine sand about 7 inches thick. The underlying material, which extends to a depth of 60 inches or more, is gray stratified fine sand and loamy fine sand in the upper part and light brownish gray fine sand in the lower part. In some places, gravelly coarse sand is within only 10 inches of the surface. Also, in places the surface layer is lighter in color than is typical. In some places, the surface layer and underlying material have less sand and more silt than is typical.

Included with this soil in mapping are small areas of Hoffland and Wildhorse soils. Hoffland soils are not stratified above 40 inches and are in slightly higher positions on the landscape. The Wildhorse soils are somewhat poorly drained, strongly affected by saline-alkali characteristics, and in higher positions than the Marlake soil. The included soils make up less than 5 percent of the map unit.

Permeability is rapid, and runoff is ponded. The available water capacity is low. The seasonal high water table fluctuates between about 2 feet above the surface and 1 foot below the surface. The content of organic matter is high.

Nearly all of the acreage of this soil supports a rank growth of cattails, rushes, and willows. It is used as habitat for wetland wildlife.

This soil is not suited to use as farmland or rangeland or to trees in windbreaks because of wetness and the ponding of water.

This soil is suited to wetland plants and provides food and shelter for wildlife.

This soil is not suited to sanitary facilities or to use as building sites because of ponding. A suitable alternate site should be considered. Constructing roads on suitable, well-compacted fill material above the ponding level and providing adequate side ditches and culverts help prevent damage to roads from ponding and wetness. Suitable alternate sites should be considered for roads.

This soil is assigned to capability unit VIIIw-7 dryland. It is in windbreak suitability group 10. It was not assigned to a range site.

Mc—McCook very fine sandy loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It formed in silty and loamy, stratified calcareous alluvium on high bottom lands. It is subject to rare flooding. The areas of this soil range from 5 to more than 500 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 8 inches thick. The subsurface layer is grayish brown very friable very fine sandy loam about 6 inches thick. A transitional layer is light brownish gray, very friable very fine sandy loam about 7 inches thick. To a depth of more than 60 inches, the underlying material is stratified light brownish gray and very pale brown very fine sandy loam. In some places the surface layer is loamy very fine sand.

Included with this soil in mapping are small areas of Glenberg and Yockey soils. The Glenberg and Yockey soils have a light colored surface layer and are in lower positions on the landscape than the McCook soil. Yockey soils are somewhat poorly drained. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is used for irrigated farming; some areas are dry-farmed. A few small areas are in native grasses and used as rangeland. Other small areas are used as pasture.

This soil is suited to dry-farmed winter wheat. The lack of precipitation is the major limitaiton, although soil blowing is a hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil increases the content of organic matter and maintains tilth and fertility.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation is an efficient way to provide supplemental water. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps improve the organic matter content and helps maintain tilth and fertility.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock or mowing to an improper height reduces the growth and vigor of the plants. Using irrigation water efficiently and applying fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture grasses.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Adapted species have a good survival rate. Cultivating between the tree rows with conventional equipment controls weeds and grasses. Hand hoeing, roto-tilling, and appropriate herbicides in the tree rows can also be used.

Flooding, though rare, is a limitation to use of this soil for sanitary facilities. Sewage lagoons need to be diked for protection from flooding. This soil is generally not suitable for building site development because of the flooding hazard. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from flooding. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIc-1 dryland and I-6 irrigated. It is in the Silty Lowland range site and in windbreak suitability group 1.

Mp—Minatare-Janise complex, 0 to 1 percent slopes. This map unit consists of areas of deep, nearly level, and somewhat poorly drained saline-alkali soils on broad bottom lands that are subject to occasional flooding. The Minatare soil formed in medium to fine textured alluvium that is high in sodium and soluble salts. The Janise soil is generally slightly lower on the landscape than the Minatare soil. The Janise soil formed in mixed loamy calcareous alluvium. Individual mapped areas are elongated and range from 10 to 640 acres. The areas are 40 to 65 percent Minatare soil and 30 to 55 percent Janise soil.

Typically, the Minatare soil has a surface layer of gray, very friable loam about 4 inches thick. It is very strongly alkaline. The subsurface layer is light gray, very friable silt loam about 3 inches thick. It is very strongly alkaline. The subsoil is light brownish gray and about 18 inches thick. It is firm silty clay in the upper part and friable clay loam in the lower part. It is very strongly alkaline. The underlying material extends to a depth of more than 60 inches. It is light gray and white sandy clay loam and loam in the upper part, where lime has accumulated, and very pale brown coarse sand in the lower part. Reaction is strongly alkaline in the upper part.

Typically, the Janise soil has a surface layer of pale brown and dark gray, friable silt loam. It is strongly alkaline. The subsurface layer is light gray, very friable silt loam. It is very strongly alkaline. The subsoil is light brownish gray and firm. It is silty clay loam in the upper part and silt loam in the lower part. The underlying material is light gray silt loam in the upper part, to a depth of about 48 inches, and light gray, gravelly sand in the lower part, to a depth of more than 60 inches. It is very strongly alkaline in the upper part and strongly alkaline in the lower part.

Included with these soils in mapping are small areas of the very poorly drained Marlake soils, the alkali phase of Yockey soils, intermittent lakes, and scabby spots. The Marlake soils are sandy and in depressions. The Yockey soil is coarser textured than the Minature and the Janise soils, but the three soils are on about the same kind of landscape. The intermittent lakes are in areas that are covered with water during some period of the year. Typically, scabby spots are areas of saline-alkali soils and saline-alkali material in small depressions that have little or no vegetation. The depressions pond rainwater. The included areas make up 5 to 20 percent of the map unit.

Permeability is very slow for the Minatare soil and moderately slow for the Janise soil. Runoff is slow. The available water capacity of these soils is moderate. The Minatare soil has an apparent seasonal high water table at a depth that ranges from about 1 foot to about 3 feet. The Janise soil has an apparent seasonal high water table at a depth that ranges from about 2 feet to about 3 feet. The organic matter content of these soils is low.

These soils contain detrimental amounts of sodium and other salts.

Most of the acreage of this map unit is in native grasses and is used as rangeland and hayland. A few small areas are used as pasture.

These soils are not suited to use as farmland because they are strongly affected by sodium. The Minatare soil, moreover, is strongly affected by salinity. These limitations are generally not practical to overcome.

These soils are suited to use as pasture, grass-legume hayland, and rangeland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Proper stocking rates, pasture rotation, and the timely deferment of grazing help maintain or improve the pasture. The saline-alkali characteristics of these soils restrict them to plants that can tolerate excess salts and strongly alkaline or very strongly alkaline conditions.

These soils are not suited to trees and shrubs in windbreaks. The soils are strongly alkaline; moreover, the Minatare soils are storngly affected by salts.

These soils are not suited to septic tank absorption fields or suitable for building site development because of flooding and wetness. A suitable alternate site should be considered. Sewage lagoons need to be lined to reduce seepage and constructed on fill material to raise the bottom of the lagoon to a sufficient height above the seasonal high water table. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from flooding, wetness, and frost action. Good surface drainage and the use of a gravel moisture barrier in the subgrade can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

These soils are assigned to capabaility unit VIs-1 dryland. They are in the Saline Subirrigated range site and in windbreak suitability group 10.

Mt—Mitchell very fine sandy loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It formed in colluvial-alluvial sediment that weathered from siltstone bedrock. It is on valley foot slopes and broad alluvial fans. The areas of this soil range from 5 to over 640 acres.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 9 inches thick. The subsurface layer is pale brown, very friable, calcareous very fine sandy loam about 7 inches thick. A transitional layer is pale brown, very friable, calcareous very fine sandy loam about 8 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of more than 60 inches. In some places the surface layer is darker in color than is typical.

Included with this soil in mapping are small areas of Otero soils. Otero soils have more sand than the Mitchell soil and are in positions on the landscape similar to those of the Mitchell soil. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate, and runoff is slow. The available water capacity is high. The water intake rate for irrigation is moderate. The content of organic matter is low. Tilth is good.

Nearly all of the acreage of this soil is cultivated. Most areas are irrigated, but some are dry-farmed. A few small areas are used as pasture.

This soil is suited to dry-farmed winter wheat. The lack of precipitation is a major limitation, although soil blowing is a hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil increases the organic matter content, improves fertility, and maintains tilth.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Land leveling increases the efficiency of a gravity irrigation system. A sprinkler system is an efficient method of irrigation on this soil. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil can improve tilth, the infiltration of water, the content of organic matter, and fertility, especially where the soil has been disturbed by land leveling.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Using irrigation water efficiently and applying fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by using conventional equipment to cultivate between the tree rows. Using appropriate herbicides or hoeing by hand help control weeds in the tree rows. Irrigation, by the drip system for example, can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and to use as building sites. Sewage lagoons need to be lined or sealed to prevent seepage. Damage to roads caused by frost action can be reduced by providing good surface drainage. Crowning the road and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIc-1 dryland and I-6 irrigated. It is in the Limy Upland range site and in windbreak suitability group 8.

MtB—Mitchell very fine sandy loam, 1 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in colluvial-alluvial sediment that weathered from siltstone bedrock and is on concave valley foot slopes and alluvial fans. The areas of this soil range from 5 to over 640 acres.

Typically, the surface layer is light brownish gray, very friable, calcareous very fine sandy loam about 9 inches thick. A transitional layer is very pale brown, very friable, calcareous very fine sandy loam about 9 inches thick. The underlying material, to a depth of 60 inches or more, is very pale brown, calcareous very fine sandy loam. In some areas, siltstone bedrock is at a depth of 20 to 40 inches. In some places the surface soil is loamy very fine sand, and the profile has more sand and less silt than is typical. Also, in places the surface layer is darker in color.

Included with this soil in mapping are small areas of Sarben soils and outcrops of gravel. Sarben soils have more sand and less silt and are in similar positions on the landscape. The outcrops of gravel are in higher positions on side slopes. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is low. Tilth is good.

Most of the acreage of this soil is farmed. Most areas are irrigated, but some are dry-farmed. A few small areas are used as pasture.

This soil is suited to dry-farmed winter wheat. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil increases the content of organic matter, improves fertility, and maintains tilth.

Under irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Managing irrigation water efficiently is a concern because of the slope. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation is an efficient way to provide supplemental water. Soil blowing is a slight hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Using a green manure crop and returning crop residue to the soil improve tilth, the infiltration of water, the organic matter content, and fertility, especially where this soil has been disturbed by land leveling operations.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Using irrigation water efficiently and fertilizing in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can be grown in soils high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by cultivating between the tree rows with conventional equipment. Using appropriate herbicides or hoeing by hand controls weeds in the tree rows. Trees can be planted on the contour to reduce erosion and excessive runoff. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally suited to septic tank absorption fields and to use as building sites. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and the shape of the lagoon. Damage to roads caused by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIe-1 dryland and IIe-6 irrigated. It is in the Limy Upland range site and in windbreak suitability group 8.

MtC—Mitchell very fine sandy loam, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed in colluvial-alluvial sediment that weathered from siltstone bedrock. It is on valley foot slopes. The areas range from 5 to 400 acres in size.

Typically, the surface layer is light brownish gray, very friable, calcareous very fine sandy loam about 9 inches thick. A transitional layer is light gray, very friable, calcareous silt loam about 6 inches thick. The underlying material is very pale brown, calcareous silt loam to a depth of 60 inches or more. In some places the surface layer is thinner or darker than is typical, and in some places the transitional layer has more clay. Also, in places siltstone bedrock is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Otero soils and Rock outcrop. Otero soils have more sand than the Mitchell soil; they are in slightly higher positions on the landscape. In some places, on the higher part of side slopes, there are outcrops of siltstone bedrock. The included areas make up 10 to 15 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is low. Tilth is good.

Most of the acreage of this soil is farmed. Most areas are irrigated, but some are dry-farmed. A few small areas are in native grasses and are used as rangeland.

This soil is suited to dry-farmed winter wheat. Water erosion is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Terraces can be installed to help prevent water erosion. Crop residue on the soil helps increase the organic matter content, improve fertility, and maintain tilth.

Under irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope and the severe water-erosion hazard. Land leveling increases the efficiency of a gravity irrigation system. On this soil, a sprinkler system is the most efficient method of irrigation. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep the crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the infiltration of water, the content of organic matter, and fertility, especially where this soil has been disturbed by land leveling operations.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by cultivating between the tree rows with conventional equipment. Using appropriate herbicides or hand hoeing helps control weeds in the tree rows. Planting trees on contour terraces allows normal cultivation between the rows; also, more moisture is stored, weeds are controlled, erosion is reduced, and excessive runoff is controlled. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally suited to septic tank absorption fields and is suitable for dwellings. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and the shape of the lagoon. Damage to roads caused by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIe-1 dryland and IIIe-6 irrigated. It is in the Limy Upland range site and in windbreak suitability group 8.

MtD—Mitchell very fine sandy loam, 6 to 9 percent slopes. This soil is deep, strongly sloping, and well drained. It formed in colluvial-alluvial sediment that weathered from siltstone bedrock and is on convex valley foot slopes. The areas of this soil range from 5 to 300 acres.

Typically, the surface layer is pale brown, very friable very fine sandy loam about 10 inches thick. The subsurface layer is brown, very friable, calcareous very fine sandy loam about 4 inches thick. A transitional layer is very pale brown, very friable, calcareous very fine sandy loam about 11 inches thick. To a depth of 60 inches or more, the underlying material is very pale brown, calcareous very fine sandy loam. In some places, siltstone bedrock is at a depth between 20 and 40 inches. Also, in places the surface layer is thinner or darker than is typical.

Included with this soil in mapping are small areas of Epping and Sarben soils and outcrops of siltstone bedrock. Epping soils are shallow to siltstone bedrock and are in higher positions on side slopes. Sarben soils have more sand and less silt than the Mitchell soil and are in positions on the landscape that are similar to those of the Mitchell soil. The outcrops of siltstone bedrock are in higher positions on side slopes. The included soils and the outcrop areas make up 10 to 15 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is low. Tilth is good.

Most of the acreage of this soil is used as irrigated or nonirrigated farmland. Some areas are in native grasses and are used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat. Water erosion is a severe hazard if the surface is not adequately protected by crops or crop residue. Conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Cover crops also help. Stripcropping helps reduce soil blowing. Terraces can be installed to help reduce water erosion. Returning crop residue to the soil increases the content of organic matter and fertility and maintains tilth.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of the slope. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Crop residue on the soil helps increase the organic matter content, improve fertility, and maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can cause severe soil losses by water erosion. Proper grazing use, the timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by cultivating between the tree rows with conventional equipment. Using appropriate herbicides or hoeing by hand can control weeds in the tree rows. Planting trees on contour terraces allows normal cultivation between the rows; also, more moisture is stored, weeds are controlled, erosion is reduced, and excessive runoff is controlled. Irrigation, by the drip system for example, can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and is suitable for dwellings. Sewage lagoons need to be lined or sealed to prevent seepage and extensive grading is required to modify the slope and the shape of the lagoon. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IVe-1 dryland and IVe-6 irrigated. It is in the Limy Upland range site and in windbreak suitability group 8.

MtE—Mitchell very fine sandy loam, 9 to 20 percent slopes. This soil is deep, moderately steep, and well drained. It formed in colluvial-alluvial sediment that weathered from siltstone bedrock. It is on concave and dissected valley foot slopes. The areas of this soil range from 10 to 250 acres.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 6 inches thick. The subsurface layer is grayish brown, very friable, calcareous very fine sandy loam about 7 inches thick. A transitional layer is pale brown, very friable, calcareous very fine sandy loam about 12 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of 60 inches or more. In some places, siltstone bedrock is at a depth between 20 and 40 inches. Also, in places the surface layer is thinner or darker than is typical.

Included with this soil in mapping are small areas of Epping soils and outcrops of gravel and siltstone bedrock. Epping soils are shallow to siltstone bedrock and are at slightly higher elevations than the Mitchell soil. The outcrops of gravel and the outcrops of siltstone bedrock are in higher positions on side slopes. The included soils and the outcrop areas make up 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is rapid. The available water capacity is high. The content of organic matter is low.

Nearly all of the acreage of this soil is in native grasses and used as rangeland.

This soil is not suited to use as farmland because of the moderately steep slope. This limitation, generally, is difficult or impractical to overcome.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by timely cultivation between the rows with conventional equipment. Using appropriate herbicides or hoeing by hand helps control the weeds in the tree rows. Trees can be planted on the contour to allow normal cultivation between the tree rows. This practice helps control weeds, improves moisture storage, and reduces erosion and the amount of runoff. Irrigation by the drip system, for example, can provide supplemental water during periods of low rainfall.

Land shaping and installing a septic tank absorption field on the contour is generally necessary for the proper operation of the septic system. This soil generally is not suited to sewage lagoons because of the moderately steep slope. A suitable alternate site should be considered for this use. It is necessary either to design dwellings to accommodate the slope or to grade the soil to an acceptable gradient. Cuts and fills generally are necessary to provide a suitable grade for roads. Damage to roads caused by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability unit VIe-1 dryland. It is in the Limy Upland range site and in windbreak suitability group 8.

MyD—Mitchell-Epping very fine sandy loams, 3 to 9 percent slopes. This map unit consists of gently sloping and strongly sloping, well drained soils. The

Mitchell soil is deep and is on valley foot slopes. The Epping soil is shallow and is on isolated knolls and narrow ridgetops. These soils formed in sediment that weathered from siltstone. Individual areas of this map unit range from 5 to 100 acres in size. The areas are made up of 50 to 60 percent Mitchell soil and 20 to 30 percent Epping soil.

Typically, the Mitchell soil has a surface layer of pale brown, very friable, calcareous very fine sandy loam about 7 inches thick. The subsurface layer is pale brown, very friable, calcareous very fine sandy loam about 7 inches thick. A transitional layer is very pale brown, very friable, calcareous very fine sandy loam about 12 inches thick. The underlying material extends to a depth of more than 60 inches. It is very pale brown and calcareous. It is very fine sandy loam in the upper part and silt loam in the lower part. In some places, siltstone bedrock is at a depth between 20 and 40 inches. Also, in places the surface layer is darker than is typical.

Typically, the Epping soil has a surface layer of very pale brown, calcareous, very friable very fine sandy loam about 6 inches thick. A transitional layer is very pale brown, calcareous very fine sandy loam about 4 inches thick. The underlying material is very pale brown, calcareous silt loam. Very pale brown, weakly cemented siltstone is at a depth of 16 inches

Included with these soils in mapping are small areas of Otero soils and outcrops of gravel and siltstone bedrock. Otero soils contain more sand than the Mitchell and the Epping soils and are in lower positions on the landscape. The outcrops of gravel and siltstone bedrock are on knolls and ridgetops. The included soils and the outcrop areas make up 10 to 20 percent of the map unit.

Permeability of these soils is moderate, and runoff is medium. The available water capacity of the Mitchell soil is high, and that of the Epping soil is low. The water intake rate for irrigation is moderate. The root zone of the Epping soil is shallow, and that of the Mitchell soil if deep. The organic matter content of these soils is low. Tilth is good.

Most of the acreage of these soils is farmed. Most areas are irrigated, but some are dry-farmed. A few small areas are used as rangeland.

These soils are poorly suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil increases the organic matter content, improves fertility, and maintains tilth.

Under irrigation, these soils are poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of the slope. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation is the most efficient system for these soils. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. The low available water capacity of the Epping soil needs to be considered in determining the application rate of irrigation water. A green manure crop and crop residue on the soil improve tilth and fertility and also help increase the water-intake rate and the content of organic matter, especially if the soil has been disturbed by land leveling operations.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system maintain or improve the range condition. Range seeding effectively reduces soil loss where the land use is changed from cropland to rangeland.

The Mitchell soil is suited to trees and shrubs in windbreaks, but the Epping soil is shallow and therefore not suited. Onsite investigation is necessary before planning a windbreak on these soils. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by timely cultivation between the rows with conventional equipment. Using herbicides appropriately or hoeing by hand helps control weeds in the tree rows. Trees that are planted on the contour help reduce erosion and excessive runoff. Irrigation by the drip system, for example, can provide supplemental water during periods of low rainfall.

Onsite investigation is necessary for all engineering construction on the soils of this map unit. The Mitchell soil generally is suited to septic tank absorption fields and is suitable for dwellings. The Epping soil generally is not suited to sanitary facilities or to use as sites for dwellings with basements because of shallowness to siltstone bedrock. On Mitchell soil, sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. On Epping soil, it is necessary to excavate the bedrock before constructing buildings that have deep foundations. It is also necessary to consider the siltstone bedrock where excavating for roads. On Mitchell soil, good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

These soils are assigned to capability units IVe-1 dryland and IVe-6 irrigated. Mitchell soil is in the Limy

Upland range site, and Epping soil is in the Shallow Limy range site. Mitchell soil is in windbreak suitability group 8, and Epping soil is in windbreak suitability group 10.

MyE—Mitchell-Epping very fine sandy loams, 9 to 20 percent slopes. This map unit consists of moderately steep, well drained soils. The Mitchell soil is deep and on alluvial fans and valley foot slopes. The Epping soil is shallow and on isolated knolls, dissected side slopes, and narrow ridgetops. These soils formed in sediment that weathered from siltstone. Individual areas of this map unit range from 5 to 300 acres. The areas are made up of 40 to 60 percent Mitchell soil and 30 to 40 percent Epping soil.

Typically, the Mitchell soil has a surface layer of brown, very friable very fine sandy loam about 7 inches thick. The subsurface layer is pale brown, very friable, calcareous very fine sandy loam about 3 inches thick. A transitional layer is very pale brown, very friable, calcareous silt loam about 10 inches thick. To a depth of more than 60 inches, the underlying material is very pale brown, calcareous silt loam. In some places, siltstone bedrock is at a depth of 20 to 40 inches. Also, in places the surface layer is darker than is typical.

Typically, the Epping soil has a surface layer of light brownish gray, very friable, calcareous very fine sandy loam about 7 inches thick. A transitional layer is pale brown, very friable, calcareous silt loam about 5 inches thick. Below this, at a depth of 12 inches, there is weakly cemented siltstone.

Included with these soils in mapping are small areas of Otero soils and outcrops of gravel and siltstone bedrock. Otero soils contain more sand and are in lower positions on the landscape. The outcrops of gravel and outcrops of siltstone bedrock are on knolls and ridgetops. The included soils and the outcrop areas make up 10 to 20 percent of the map unit.

Permeability of these soils is moderate. Runoff is rapid. The available water capacity is high for the Mitchell soil and low for the Epping soil. The organic matter content of these soils is low. The root zone is shallow for the Epping soil and deep for the Mitchell soil.

Nearly all of the acreage of these soils is rangeland.

These soils are not suited to use as farmland because of moderately steep slopes, droughtiness, soil blowing, and water erosion and because of the shallow root zone in the Epping soil. These hazards and the slope limitation generally are difficult or impractical to overcome.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be necessary to control undesirable woody plants on the steeper slopes.

The Mitchell soil is suited to trees and shrubs in windbreaks, but the Epping soil is shallow and not suited. Onsite investigation is necessary before planning a windbreak on these soils. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Using herbicides appropriately or hoeing by hand helps control weeds in the tree rows. Trees can be planted on the contour to help reduce erosion and excessive runoff. Irrigation can provide supplemental water during periods of low rainfall. The drip system of irrigation is commonly used.

Onsite investigation is necessary for all engineering construction on the soils of this map unit. These soils generally are not suited to septic tank absorption fields and sewage lagoons. A suitable alternate site should be considered. On the Mitchell soil, it is necessary to design dwellings to accommodate the slope or to grade the slope. On Epping soil, the siltstone bedrock must be excavated in order to construct dwellings with basements. Dwellings on this soil also need to be designed to accommodate the slope. On Mitchell soil, cuts and fills generally are needed to provide a suitable grade for roads. Damage to the roads caused by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. On Epping soil, the bedrock must be considered when excavating for roads.

These soils are assigned to capability unit VIe-1. The Mitchell soil is in the Limy Upland range site, and the Epping soil is in the Shallow Limy range site. The Mitchell soil is in windbreak suitability group 8, and the Epping soil is in windbreak suitability group 10.

OcD—Oglala-Canyon very fine sandy loams, 3 to 9 percent slopes. This map unit consists of gently sloping and strongly sloping, well drained soils on uplands. The deep Oglala soil is on broad convex ridgetops and on convex side slopes dissected by drainageways. The Canyon soil is shallow and on ridgetops, sharp slope breaks, and the upper parts of the slope. The soils formed in materials that weathered from fine-grained sandstone. The areas of this map unit range from 5 to 140 acres in size. The areas are 50 to 80 percent Oglala soil and 10 to 30 percent Canyon soil.

Typically, the Oglala soil has a surface layer of grayish brown, very friable very fine sandy loam about 18 inches thick. A transitional layer is grayish brown, very friable very fine sandy loam about 9 inches thick. The underlying material is very fine sandy loam. It is light brownish gray in the upper part and light gray in the lower part. Weakly cemented limy sandstone is at a depth of 54 inches and extends to a depth of more than

60 inches. In some places the surface layer is lighter in color and thinner than is typical, and, in places it has some gravel. Also, in places the transitional layer is coarser textured.

Typically, the Canyon soil has a surface layer of grayish brown, very friable, calcareous very fine sandy loam about 8 inches thick. The underlying material is pale brown, very friable, calcareous very fine sandy loam. White, weakly cemented limy sandstone is at a depth of 15 inches. In some places the soil contains more sand than is typical.

Included with these soils in mapping are small areas of Duroc soils, outcrops of sandstone bedrock, and loamy soils that of 20 to 40 inches deep to bedrock. Duroc soils are finer textured and are on concave parts of side slopes and alluvial fans. The outcrops of soft sandstone are on narrow ridgetops and sharp slope breaks. In places the bedrock is high in clay. The loamy soils are on foot slopes. The included soils and the outcrop areas make up 10 to 20 percent of the map unit.

Permeability is moderate, and runoff is medium. The available water capacity is moderate for the Oglala soil and very low for the Canyon soil. The water intake rate for irrigation is moderate. The content of organic matter is moderate for the Oglala soil and low for the Canyon soil. The root zone is shallow for the Canyon soil. Tilth is good.

The acreage of these soils is either dry-farmed or used as rangeland.

These soils are poorly suited to dry-farmed crops, including winter wheat and millet. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil increases the organic matter content and maintains tilth.

Under sprinkler irrigation, these soils are poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The Canyon soil is shallow and requires more frequent irrigation because of its low available water capacity. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Returning crop residue to the soil helps increase the organic matter content and the fertility of these soils. Crop residue also helps maintain tilth.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

The Oglala soil is suited to trees and shrubs in windbreaks; the Canyon soil is not suited because of a shallow root zone. Onsite investigation is necessary before planning a windbreak on these soils. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. On the Oglala soil, trees can be planted on the contour to reduce erosion and excessive runoff of water. The area between the tree rows can be cultivated with conventional equipment. Using appropriate herbicides in the tree rows also helps control undesirable weeds and grasses. The areas around the small trees can be hoed by hand or roto-tilled. Insufficient rainfall restricts the growth of trees on the Oglala soil. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system, for example, is commonly used.

Onsite investigation is needed for all engineering construction on these soils. The soils generally are not suited to Septic tand absorption fields because of the shallow or moderate depth to bedrock; therefore, a suitable alternate should be considered. Sewage lagoons can be constructed on the Oglala soil, but the bottom of the lagoon has to be lined or sealed to prevent seepage. Grading is necessary to modify the slope and shape the lagoon. The Canyon soil generally is not suited to sewage lagoons because of shallowness. A suitable alternate site should be considered. The Oglala soil is generally suitable for dwellings. On Canyon soil, it is necessary to excavate the bedrock before constructing dwellings that have basements or buildings that have deep foundations. The bedrock of the Canyon soil also must be considered if excavating is necessary for the building of roads. On Oglala soil, damage to roads caused by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

These soils are assigned to capability units IVe-1 dryland and IVe-6 irrigated. The Oglala soil is in the Silty range site, and the Canyon soil is in the Shallow Limy range site. The Oglala soil is in windbreak suitability group 3, and the Canyon soil is in windbreak suitability group 10.

OfC—Otero loamy very fine sand, 0 to 6 percent slopes. This soil is deep, very gently sloping and gently sloping, and well drained. It formed in colluvial-alluvial sediment and is on valley foot slopes and alluvial fans. The areas of this soil range from 15 to 180 acres in size.

Typically, the surface layer is light brownish gray, friable, calcareous loamy very fine sand about 7 inches thick. A transitional layer is pale brown, very friable, calcareous loamy very fine sand about 7 inches thick. The underlying material is calcareous loamy very fine sand to a depth of 60 inches or more. It is pale brown in the upper part and very pale brown in the lower part.

Included with this soil in mapping are small areas of Alice, Mitchell, Sarben, and Valent soils. The Alice soils have a darker and thicker surface layer than that of the Otero soil; they are on stream terraces. The Mitchell soils have more silt and are in similar positions on the landscape. Sarben soils do not have carbonates within a depth of 40 inches and are on hummocks on a landscape similar to that of the Otero soil. The Valent soils are sandy and are on hummocks and dunes. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderately rapid, and runoff is slow. The available water capacity is moderate. The water intake rate for irrigation is high. The content of organic matter is low, and tilth is fair.

The acreage of this soil is farmed or is in native grasses and is used as rangeland. The farmed areas are both irrigated and nonirrigated.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil improves tilth and fertility and increases the content of organic matter.

If sprinkler irrigation is used, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Soil blowing is a very severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps improve tilth, the organic matter content, and fertility.

This soil is suited to rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding effectively reduces soil loss if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Strips of sod or a cover crop on the soil can reduce soil blowing. Trees planted on the contour reduce erosion. Irrigation, by the drip system for example, can provide supplemental water during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage. This soil is generally suited to use for dwellings and roads. The walls or sides of shallow excavations can be shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-5 dryland and IVe-10 irrigated. It is in the Sandy range site and in windbreak suitability group 8.

OfE—Otero loamy very fine sand, 9 to 20 percent slopes. This soil is deep, moderately steep, and well drained. It formed in colluvial-alluvial sediment on concave and dissected valley foot slopes. The areas of this soil range from 10 to 80 acres.

Typically, the surface layer is light brownish gray, very friable loamy very fine sand about 6 inches thick. A transitional layer is light brownish gray, very friable, calcareous loamy very fine sand about 8 inches thick. To a depth of more than 60 inches, the underlying material is calcareous loamy very fine sand. It is light brownish gray in the upper part and pale brown in the lower part. In some places the surface layer is darker in color and thicker than is typical. Also, in places the soil has more silt and less sand.

Included with this soil in mapping are small areas of Sarben and Valent soils and outcrops of gravel. Sarben soils do not have carbonates within a depth of 40 inches and are on hummocks on a landscape similar to that of the Otero soil. The Valent soils are sandy and noncalcareous to a depth of 40 inches. They are on hummocks and dunes. The outcrops of gravel are on knolls. The included soils make up about 10 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is rapid, and the available water capacity is moderate. The content of organic matter is low.

Nearly all of the acreage of this soil is in native grasses and used as rangeland.

This soil is not suited to use as farmland because of moderately steep slopes. This limitation is difficult or impractical to overcome.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It also results in severe losses by soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing sytem help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can be grown in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Strips of sod or a cover crop can reduce soil blowing. Trees can be planted on the contour to reduce erosion and excessive runoff. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is necessary to modify the slope and shape the lagoon. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. Dwellings should be designed to accommodate the slope, or the site should be graded. Cuts and fills generally are needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-5. It is in the Sandy range site and in windbreak suitability group 8.

OtB—Otero very fine sandy loam, 0 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in colluvial-alluvial sediment on valley foot slopes and alluvial fans. The areas of this soil range from 5 to 180 acres.

Typically, the surface layer is light brownish gray, very friable, calcareous very fine sandy loam about 8 inches thick. A transitional layer is light brownish gray, very friable, calcareous very fine sandy loam about 7 inches thick. The underlying material, to a depth of more than 60 inches, is very pale brown, calcareous very fine sandy loam. In some places the surface layer is darker in color than is typical and is not calcareous. Also, in places the soil contains more silt and less sand.

Included with this soil in mapping are small areas of Otero Variant, Sarben, and Valent soils. The Otero Variant soils are somewhat poorly drained. They have a high water table and are in a lower position on the landscape than the Otero soil. Sarben soils do not have carbonates within a depth of 40 inches and are on hummocks that are higher on the landscape. The Valent soils are sandy, excessively drained, and on hummocks and dunes that are in higher positions on the landscape. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is high, and the water intake rate for irrigation is moderately high. The content of organic matter is low. Tilth is good.

This soil is used for farming. It is also used as rangeland. Most farmed areas are irrigated, but some are dry-farmed. A few small areas are used as pasture.

This soil is suited to dry-farmed winter wheat. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil increases the content of organic matter, improves fertility, and maintains tilth.

Under irrigation, this soil is suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation is the most efficient system for this soil. Soil blowing is a slight hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the infiltration of water, the organic matter content, and fertility, especially if this soil has been disturbed by land leveling operations.

This soil is suited to irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Using water for irrigation efficiently and applying fertilizer in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by cultivating between the tree rows with conventional equipment. Using appropriate herbicides or hoeing by hand can control the weeds in the tree rows. Trees can be planted on the contour to reduce erosion. Irrigation by the drip system, for example, can provide supplemental water during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage. This soil is generally suited to dwellings, roads, and streets. The walls or sides of shallow excavations can be shored to prevent sloughing or caving.

This soil is assigned to capability units IIIe-3 dryland and IIe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 8.

OtC—Otero very fine sandy loam, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed in colluvial-alluvial sediment. It is on valley foot slopes and alluvial fans. The areas of this soil range from 5 to 80 acres in size.

Typically, the surface layer is brown, very friable very fine sandy loam about 7 inches thick. A transitional layer is pale brown, very friable, calcareous very fine sandy loam about 9 inches thick. The underlying material is pale brown, calcareous very fine sandy loam to a depth of 60 inches or more. In some places the surface layer is darker in color, thicker, and free of carbonates. Also, in places the soil contains more silt and less sand.

Included with this soil in mapping are small areas of Otero Variant, Sarben, and Valent soils. The Otero Variant soils are somewhat poorly drained, have a seasonal high water table, and are lower on the landscape than the Otero soil. Sarben soils do not have carbonates within a depth of 40 inches. They are on hummocks in higher positions on the landscape. The Valent soils are sandy, excessively drained, and on hummocks and dunes in higher positions. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is high. The water intake rate for irrigation is moderately high. The content of organic matter is low, and tilth is good.

This soil is used as farmland and rangeland. Some of the farmed areas are irrigated, some are not.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil helps increase the content of organic matter, improve fertility, and maintain tilth.

Under sprinkler irrigation, this soil is suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Using a green manure crop and returning crop residue to the soil improve tilth, the infiltration of water, the organic matter content, and fertility, especially if the soil has been disturbed by land leveling.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by cultivating between the rows with conventional equipment. Using appropriate herbicides and hoeing by hand can control weeds in the tree rows. Trees can be planted on the contour to help reduce erosion. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage. This soil is generally suited to dwellings and roads. The walls or sides of shallow excavations can be shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-3 dryland and IIIe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 8.

OtD—Otero very fine sandy loam, 6 to 9 percent slopes. This soil is deep, strongly sloping, and well drained. It formed in colluvial-alluvial sediment and is on valley foot slopes. The areas of this soil range from 5 to 120 acres.

Typically, the surface layer is pale brown, very friable, calcareous very fine sandy loam about 9 inches thick. A transitional layer is pale brown, very friable, calcareous very fine sandy loam about 10 inches thick. The underlying material, to a depth of more than 60 inches, is very pale brown, calcareous very fine sandy loam. In some places the surface layer is darker and free of carbonates. Also, in places the soil contains more silt and less sand.

Included with this soil in mapping are small areas of Sarben and Valent soils. Sarben soils typically, do not have carbonates within a depth of 40 inches. They are on hummocks in positions on the landscape similar to those of the Otero soil. The Valent soils are sandy and are on hummocks and dunes. They are noncalcareous to a depth of 40 inches. The included soils make up 10 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is high. The water intake rate for irrigation is moderately high. The content of organic matter is low, and tilth is good.

Most of the acreage of this soil is used as rangeland. A few small areas are dry-farmed or irrigated by sprinklers.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil increases the organic matter content, improves fertility, and maintains tilth.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of excessive slope and severe soil erosion. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps maintain or improve tilth, the infiltration of water, the organic matter content, and fertility.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding is necessary to establish a protective vegetative cover if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can grow in soils that are high in calcium carbonate. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation and by cultivating between the tree rows with conventional equipment. Using appropriate herbicides or hoeing by hand controls weeds in the tree rows. Trees can be planted on the contour to help reduce erosion. Irrigation, by the drip system for example, can provide supplemental water during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. This soil is generally suited to dwellings and roads. The walls or sides of shallow excavations can be shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-3 dryland and IVe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 8.

Ov—Otero Variant very fine sandy loam, 0 to 2 percent slopes. This soil is deep, nearly level, and somewhat poorly drained. It formed in colluvial-alluvial sediment and is on concave valley foot slopes and alluvial fans. This soil receives seep water from irrigation canals. The areas of this soil range from 5 to 140 acres.

Typically, the surface layer is light brownish gray, very friable, calcareous very fine sandy loam about 10 inches thick. A transitional layer is light brownish gray, very friable, calcareous very fine sandy loam about 8 inches thick. The underlying material is light gray, very fine sandy loam. It is mottled in the upper part. In some places the surface layer is silt loam.

Included with this soil in mapping are small areas of the well drained Mitchell and Sarben soils and intermittent lakes. Mitchell soils have more silt and less sand than the Otero Variant soil. Sarben soils do not have carbonates within a depth of 40 inches. The Mitchell and Sarben soils are in slightly higher positions on the landscape. Also included are areas where the seasonal high water table is at a depth of 60 inches or more. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid, and runoff is slow. The available water capacity is high. The water intake rate for irrigation is moderately high. The apparent seasonal high water table is at a depth of about 1.5 to 3.5 feet during the irrigation season. Irrigation water management affects the water table level. The content of organic matter is low, and tilth is good.

Most of the acreage of this soil is farmed under irrigation, but a few small areas are dry-farmed. A few small areas are used as rangeland or pasture.

This soil is suited to dry-farmed winter wheat. Wetness is a limitation. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil increases the organic matter content, improves fertility, and maintains tilth.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Wetness may be a limitation during or following the irrigation season. Land leveling increases the efficiency of a gravity irrigation system. A sprinkler system can be used to increase the efficiency of irrigation. Soil blowing is a slight hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface. The crop residue on the soil helps control soil blowing and conserves moisture. It also increases the content of organic matter, improves fertility, and helps maintain tilth.

This soil is suited to use as pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Using irrigation water efficiently and fertilizing in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to use as rangeland for either grazing or haying. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet can cause small mounds to form. The mounds make grazing or harvesting for hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately high seasonal high water table. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees should be planted after the soil has begun to dry. The areas near the trees can be hoed by hand or roto-tilled. Supplemental water may be needed during periods of low rainfall. The drip system is commonly used.

This soil generally is not suited to sanitary facilities or to dwellings with basements because of wetness. A suitable alternate site should be considered for these uses. It is necessary to construct dwellings on raised, well-compacted fill material to overcome wetness caused by the seasonal high water table. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help prevent damage to roads from wetness. Damage to roads caused by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIw-6 dryland and IIIw-8 irrigated. It is in the Subirrigated range site and in windbreak suitability group 2S.

Pb—Pits and Dumps. This map unit consists mainly of deep, gently sloping and steep mounds of gravel, sand, and overburden and adjacent pits on bottom lands and stream terraces. The pits typically have water in them, and the sand and gravel areas are excessively drained. The dumps on the bottom lands are subject to rare flooding. The areas of this map unit range from 2 to 125 acres in size.

Typically, the soil material consists of a mixture of medium and fine sand and some gravel. There is no development of a soil profile.

Included in mapping this unit are small areas of Dix and Gothenburg soils. These soils are lower on the landscape than the mounds of sand but are higher than the pit areas. The included soils make up 10 to 25 percent of the map unit.

Permeability is very rapid or rapid. Runoff is very slow. The available water capacity is very low. The water level in the pits generally is 5 to 10 feet lower than the adjacent land surface. The organic matter content is very low. Typically, the mounds of sand have no vegetation.

Most of the areas are used for the commercial mining of sand and gravel. Some areas, where mining has stopped, are used as habitat for wildlife or for recreational purposes.

The areas are not suited to farming because of a shallow root zone, low moisture supply, and steep slopes.

Pits and Dumps are not suited to use as rangeland because of sand blowing and steep slopes. In some places where the sand and gravel are no longer mined, sparse vegetation gradually becomes established. The steeply sloping areas can be shaped to modify the slope.

The areas generally are not suited to trees and shrubs in windbreaks because the root zone is too shallow, the moisture supply is too low, and sand blowing is a hazard.

The areas generally are not suitable as camping sites because flooding is a hazard and the soil material is too sandy. The soil material is too sandy also for picnic areas, playgrounds, paths, and trails. The slopes are too steep for playgrounds.

The areas of this map unit generally are not suitable for sanitary facilities or dwellings because of the rapid and very rapid permeability and the flooding hazard. Extensive cuts and fills generally are needed to provide a suitable grade if roads are to be built.

This map unit is assigned to capability unit VIIIs-8 dryland and to windbreak suitability group 10. It is not assigned to a range site.

Pt—Platte loam, 0 to 1 percent slopes. This soil is shallow over gravelly coarse sand. It is nearly level and somewhat poorly drained. It formed in loamy alluvium that was deposited over sandy and gravelly material on bottom lands and is subject to occasional flooding, especially when ice jams the North Platte River channels. The areas of this soil range from 5 to 200 acres.

Typically, the surface layer is dark grayish brown, friable loam about 5 inches thick. The underlying material, to a depth of 16 inches, is stratified grayish brown and light brownish gray fine sandy loam and very fine sandy loam. Below that, to a depth of 60 inches or more, there is light gray, stratified, gravelly coarse sand.

Included with this soil in mapping are small areas of Barney, Gering, Gothenburg, and Janise soils. The Barney soils are poorly drained, are subject to frequent flooding, and are in lower positions on the landscape. Gering soils have gravelly coarse sand at a depth of 20 to 40 inches. Gothenburg soils are subject to frequent flooding. They have a surface layer that is lighter in color than that of the Platte soil Janise soils are strongly affected by saline-alkali characteristics. The Gering, Gothenburg, and Janise soils are in positions on the landscape similar to those of the Platte soil. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the upper part of the soil and very rapid in the lower part. Runoff is slow, and the available water capacity is low. The apparent seasonal high water table is at a depth of about 1 foot to 2 feet.

The water intake rate for irrigation is moderately low to moderate. The content of organic matter is moderately low. The root zone is shallow. Tilth is good.

Most of the acreage of this soil is used as rangeland and as hayland. A few small areas are farmed under sprinkler irrigation.

This soil is not suited to dry-farmed crops. Soil blowing is a moderate hazard. The shallow root zone and wetness are limitations. This soil is usually wet in the spring and is droughty in the summer when the depth to the water table increases.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, dry edible beans, and alfalfa. Wetness is a limitation during the early part of the growing season in most years. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Irrigation is necessary because of the low available water capacity of the soil. Crop residue on the soil increases the content of organic matter, improves fertility, and helps maintain tilth.

This soil is suited to use as rangeland for either grazing or haying. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet can cause small mounds to form. The mounds make grazing or harvesting for hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition.

This soil is poorly suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately high water table in the spring. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees should be planted after the soil has begun to dry. The areas near the trees can be hoed by hand or roto-tilled. Supplemental water, irrigation by the drip system for example, may be necessary in the summer after the water table begins to lower.

This soil is not suitable for use as sanitary facilities or building sites because of flooding and wetness. A suitable alternate site should be considered for these uses. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from flooding and wetness.

This soil is assigned to capability units VIw-4 dryland and IVw-13 irrigated. It is in the Subirrigated range site and in windbreak suitability group 2S.

ReG—Rock outcrop-Epping complex, 20 to 60 percent slopes. This complex consists of very steeply sloping rock outcrops and Epping soil on upland breaks. The outcrops of siltstone are on the steeper part of ridgetops and on dissected side slopes of breaks. The Epping soil is shallow and excessively drained. It is on side slopes and narrow ridgetops and has slopes of 20 to 30 percent. It formed in material that weathered from siltstone. The areas of this map unit are 30 to 50 percent Rock outcrop and 30 to 50 percent Epping soil. The areas are 10 to 275 acres in size.

Typically, Rock outcrop consists of weakly cemented limy siltstone bedrock. In places, it has interlayers of sandstone bedrock.

Typically, the Epping soil has a surface layer of very pale brown, very friable, calcareous silt loam about 5 inches thick. The underlying material is very pale brown, calcareous silt loam. Weakly cemented siltstone is at a depth of 11 inches.

Included with this complex in mapping are small areas of Bridget, Keota, and Mitchell soils and areas of badland. The Bridget soils are deep and have a darker and thicker surface layer. They are on foot slopes in lower positions on the landscape. The Keota soils are moderately deep and are on the lower part of side slopes and also on foot slopes. The Mitchell soils are deep and are on alluvial fans and foot slopes in lower positions on the landscape. The areas of badland are on sharp slope breaks. The included soils make up 10 to 20 percent of the map unit.

Permeability of the Epping soil is moderate. Runoff on the Epping soil is rapid; runoff on the rock outcrops is very rapid. The available water capacity of the Epping soil is low, and the organic matter content is also low. The root zone of the Epping soil is shallow.

Nearly all of the acreage of this complex is used as rangeland.

This complex is not suited to farming because of the shallow root zone, excessive slope, and the rock outcrops.

The Epping soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be necessary to control undesirable woody plants on the steeper slopes.

The Epping soil is generally not suited to trees and shrubs in windbreaks because the soil is too steep and too shallow.

The Epping soil generally is not suited to sanitary facilities or to building sites because of the steep slopes and shallowness. A suitable alternate site should be considered. Cuts and fills are generally needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIIs-3 dryland. The Epping soil is in the Shallow Limy range site and in windbreak suitability group 10. Rock outcrop was not assigned to a range site or to a windbreak suitability group.

RtG—Rock outcrop-Tassel complex, 20 to 60 percent slopes. This complex consists of areas of sandstone outcrops and Tassel soil on upland breaks. The areas are steep and very steep and somewhat excessively drained and excessively drained. The outcrops of sandstone are on the steeper upper side slopes and ridgetops and the upper part of dissected side slopes of breaks. The Tassel soil is shallow and is on side slopes and narrow ridgetops. It formed in material that weathered from fine-grained sandstone. The areas of this map unit range from 5 to 640 acres or more in size. They are made up of 30 to 50 percent outcrops of sandstone and 30 to 50 percent Tassel soil.

Typically, Rock outcrop consists of blocky fine-grained sandstone bedrock. In places, there are interlayers of siltstone bedrock and unconsolidated material.

Typically, the Tassel soil has a surface layer of light brownish gray, very friable, calcareous loamy very fine sand about 9 inches thick. The underlying material is light gray, calcareous loamy very fine sand. In some places the soil is finer textured than is typical. Weakly cemented sandstone is at a depth of 18 inches. In places the depth to sandstone bedrock is less than 10 inches. In places the underlying bedrock is siltstone.

Included in mapping are small areas of Bridget, Busher, and Otero soils. Slopes of Busher soils do not exceed 30 percent, and slopes of Bridget and Otero soils do not exceed 20 percent. The Bridget soils are deep, have more silt and less sand, and do not have sandstone bedrock within a depth of 60 inches. They are on valley foot slopes. The Busher soils are deep, have a darker and thicker surface layer, and are on convex side slopes. The Otero soils are deep. They are on valley foot slopes. The included soils make up 10 to 20 percent of the map unit.

Permeability of the Tassel soil is moderately rapid. Runoff on the Tassel soil is rapid, and runoff on the rock outcrops is very rapid. The available water capacity of the Tassel soil is very low. The organic matter content of this soil is also low. The root zone of the Tassel soil is shallow.

Nearly all of the acreage of this map unit is used as rangeland. A few ponderosa pine commonly grow on the Tassel soil.

This complex is not suited to farming because of the shallow root zone, excessive slope, and rock outcrops.

The Tassel soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be necessary to control undesirable woody plants on the steeper slopes.

The Tassel soil is generally not suited to trees and shrubs in windbreaks because the soil is too steep and too shallow.

The Tassel soil generally is not suited to sanitary facilities or to building sites because of the steep and very steep slopes and the shallow depth to bedrock. A suitable alternate site should be considered for these uses. Cuts and fills are generally needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIIs-3 dryland. Tassel soil is in the Shallow Limy range site and in windbreak suitability group 10. Rock outcrop was not assigned to a range site or a windbreak suitability group.

SbD—Sarben loamy very fine sand, 3 to 9 percent slopes. This soil is deep, gently sloping and strongly sloping, and well drained. It formed in loamy and sandy wind-reworked material that weathered from sandstone bedrock on stream terraces and valley side slopes. In some places it is on hummocks. The areas of this soil range from 5 to 425 acres.

Typically, the surface layer is grayish brown, very friable loamy very fine sand about 7 inches thick. A transitional layer is light brownish gray, very friable loamy very fine sand about 8 inches thick. The underlying material extends to a depth of more than 60 inches. It is light brownish gray loamy very fine sand in the upper part and light gray very fine sandy loam in the lower part. In some places the surface layer is darker and thicker than is typical. Also, in places free carbonates are near the surface.

Included with this soil in mapping are small areas of Valent soils. Valent soils have more sand than the Sarben soil, but they and the Sarben soil are in similar positions on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is slow. The available water capacity is moderate, and the water intake rate for irrigation is moderately high. The content of organic matter is low. Tilth is fair.

Most of the acreage of this soil is in native grasses and used as rangeland. A few small areas are used as farmland. Some of the areas are irrigated and some are dry-farmed.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing is a very severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Returning crop residue to the soil improves tilth and fertility and increases the content of organic matter.

Under irrigation, this soil is poorly suited to crops, including corn and alfalfa. Sprinkler irrigation is most efficient on this soil. Soil blowing is a very severe hazard. A winter cover crop helps reduce soil blowing.

Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil improves tilth, the organic matter content, and fertility.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazings can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing sytem help maintain or improve the range condition. Range seeding may be necessary to stabilize the soil if cropland is eroded.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Trees should be planted in a shallow furrow or a narrow roto-tilled strip with as little disturbance of the soil as possible. Sod should be maintained between the tree rows and in the tree rows. The areas near the trees can be hoed by hand. Supplemental water may be needed during periods of low rainfall. Irrigation by the drip system is commonly used.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. This soil is generally suited to dwellings and roads.

This soil is assigned to capability units IVe-5 dryland and IVe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 7.

SbE—Sarben loamy very fine sand, 9 to 17 percent slopes. This soil is deep, moderately steep, and well drained. It formed in loamy and sandy wind-reworked materials that weathered from sandstone bedrock on stream terraces and valley side slopes. The areas of this soil range from 5 to 200 acres.

Typically, the surface layer is grayish brown, very friable loamy very fine sand about 6 inches thick. A transitional layer is pale brown, very friable loamy very fine sand about 17 inches thick. To a depth of more than 60 inches, the underlying material is very fine sandy loam. It is pale brown in the upper part and very pale brown in the lower part. In some places the surface layer is thicker and darker than is typical. Also, in places free carbonates are near the surface.

Included with this soil in mapping are small areas of Valent soils. Valent soils have more sand than the Sarben soil. They and the Sarben soil are in similar positions on the landscape. Small areas of steep soils are also included. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate, and the content of organic matter is low.

Nearly all of the acreage of this soil is in native grasses and used as rangeland.

This soil is generally not suited to use as farmland because of the moderately steep slope and the very severe hazard of soil blowing. This hazard and the slope limitation, generally, are difficult or impractical to overcome.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It also can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be necessary to control undesirable woody plants.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. It is necessary to plant trees in a shallow furrow or a narrow roto-tilled strip with as little disturbance of the soil as possible. Sod should be maintained between the tree rows and in the rows. The areas near the trees can be hoed by hand. Supplemental water, irrigation by the drip system for example, may be needed during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and extensive grading is required to modify the slope and shape the lagoon. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. It is necessary either to design dwellings to accommodate the slope or to grade the slope. Cuts and fills are generally needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-5 dryland. It is in the Sandy range site and in windbreak suitability group 7.

ScB—Sarben very fine sandy loam, 1 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in loamy and sandy wind-reworked materials that weathered from sandstone bedrock. It is on stream terraces and valley side slopes. The areas of this soil range from 5 to 130 acres.

Typically, the surface layer is brown, very friable very fine sandy loam about 5 inches thick. A transitional layer is pale brown, very friable loamy very fine sand about 17 inches thick. The underlying material is light brownish gray loamy very fine sand to a depth of 60 inches or more. In some places the surface layer is darker and thicker than is typical. Also, in places free carbonates are near the surface.

Included with this soil in mapping are small areas of Valent soils. Valent soils have more sand than the Sarben soil and are in slightly higher positions on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderately rapid, and runoff is slow. The available water capacity is moderate. The water intake rate for irrigation is moderately high. The content of organic matter is moderately low, and tilth is good.

Most of the acreage of this soil is used as cropland and rangeland. The cropland is irrigated or dry-farmed. A few small areas are used as pasture.

This soil is suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Cover crops also help. Stripcropping helps reduce soil blowing. Crop residue on the soil helps increase the content of organic matter, improve fertility, and maintain tilth.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation is an efficient system on this soil. Soil blowing is a slight hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the water intake rate, the organic matter content, and fertility, especially where the soil has been disturbed by land leveling.

This soil is suited to use as irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Using irrigation water efficiently and fertilizing in amounts based on soil tests are management concerns. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding effectively reduces soil loss if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by using appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Irrigation by the drip system, for example, can provide supplemental water during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. This soil is generally suited to dwellings and roads.

This soil is assigned to capability units IIIe-3 dryland and IIe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

ScD—Sarben very fine sandy loam, 3 to 9 percent slopes. This soil is deep, gently sloping and strongly sloping, and well drained. It formed in loamy and sandy wind-reworked materials that weathered from sandstone bedrock on stream terraces and valley side slopes. The areas of this soil range from 5 to 275 acres in size.

Typically, the surface layer is light brownish gray, very friable very fine sandy loam about 4 inches thick. A transitional layer is very pale brown, very friable, loamy very fine sand about 12 inches thick. The underlying material, to a depth of more than 60 inches, is very pale brown loamy very fine sand. In some places the surface layer is darker and thicker than is typical. Also, in places free carbonates are near the surface.

Included with this soil in mapping are small areas of Valent soils. Valent soils have more sand than the Sarben soil. They and the Sarben soil are in similar positions on the landscape.

Permeability is moderately rapid. Runoff is medium. The available water capacity is moderate. The water intake rate for irrigation is moderately high. The content of organic matter is moderately low, and tilth is good.

Most of the acreage of this soil is in native grasses and used as rangeland, although the soil is used as farmland in some areas. The farmland is both irrigated and dry-farmed.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residues on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil improves the organic matter content and fertility and maintains tilth.

Under irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa.

Sprinkler irrigation is the most efficient system to use on this soil (fig. 11). Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil helps increase the organic matter content, improve fertility, and maintain tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing. A proper grazing system helps maintain or improve the range condition. Range seeding can effectively reduce soil loss if the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by using appropriate herbicides. Soil blowing can be controlled by strips of sod or a cover crop between the tree rows. Irrigation by the drip system, for example, can provide additional moisture during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is necessary to modify the slope. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. This soil is generally suited to dwellings and roads.

This soil is assigned to capability units IVe-3 dryland and IVe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

TaG—Tassel loamy very fine sand, 20 to 50 percent slopes. This soil is shallow, very steep, and excessively drained. It formed in loamy and sandy calcareous material that weathered from fine-grained sandstone bedrock. It is on dissected side slopes and summits of narrow upland ridgetops. The areas of this soil range from 40 to over 640 acres.

Typically, the surface layer is brown, very friable, calcareous loamy very fine sand about 6 inches thick. The underlying material is pale brown, calcareous loamy very fine sand. Bedrock, at a depth of about 13 inches, is very pale brown, weakly cemented fine-grained

Figure 11.—A sprinkler system is used to irrigate dry edible beans on Sarben very fine sandy loam, 3 to 9 percent slopes.

sandstone. In some places the soil is finer textured than is typical. Also, in places the depth to sandstone bedrock is less than 10 inches.

Included with this soil in mapping are small areas of Busher, Dix, and Otero soils and outcrops of sandstone bedrock. The Busher soils are deep, have a darker and thicker surface layer than that of the Tassel soil, and are on convex side slopes. The Dix soils are excessively drained. They are underlain by very gravelly coarse sand and are in positions on the landscape that are similar to those of the Tassel soil. The Otero soils are deep and on valley foot slopes. Outcrops of sandstone bedrock are on narrow ridgetops and sharp slope breaks. The included soils make up 10 to 15 percent of the map unit.

The permeability is moderately rapid, and runoff is rapid. The available water capacity is very low. The content of organic matter is low. The root zone is shallow.

Nearly all of the acreage of this soil is used as rangeland.

This soil is not suited to use as farmland because of very steep slopes, a shallow root zone, and water erosion.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion (fig. 12). Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants on the steeper slopes.

This soil is generally not suited to trees and shrubs in windbreaks because it is too steep and too shallow.

The Tassel soil generally is not suited to sanitary facilities or to use as building sites because of the very steep slope and the shallowness to bedrock. A suitable alternate site should be considered for these uses. Cuts and fills are needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIIs-4 dryland. It is in the Shallow Limy range site and in windbreak suitability group 10.

TbF—Tassel-Busher loamy very fine sands, 3 to 30 percent slopes. This map unit consists of gently sloping to steep, somewhat excessively drained soils on uplands. The Tassel soil is shallow and is on summits and side slopes of narrow ridgetops, convex dissected side slopes, and sharp slope breaks. The Busher soil is deep and is on convex summits and side slopes. These soils formed in material that weathered from fine-grained sandstone. In places the soils are on isolated knolls in the sandhills. The areas of this map unit range from 5 to more than 640 acres in size. They are 35 to 65 percent Tassel soil and 25 to 50 percent Busher soil.

Typically, the Tassel soil has a surface layer of grayish brown, friable loamy very fine sand about 4 inches thick. The underlying material is calcareous fine sandy loam. It is light brownish gray in the upper part and light gray in the lower part. Bedrock, at a depth of about 17 inches, is weakly cemented fine-grained sandstone. In some places there is more clay in the soil than is typical. Also, in places the depth to sandstone bedrock is less than 10 inches.

Typically, the Busher soil has a surface layer of grayish brown, friable loamy very fine sand about 7 inches thick. The subsoil is pale brown, very friable loamy very fine sand about 11 inches thick. The underlying material is calcareous loamy very fine sand that is pale brown in the upper part and very pale brown in the lower part. At a depth of 57 inches, and extending to a depth of more than 60 inches, there is white, weakly cemented, limy sandstone bedrock. In some places the surface layer is loamy sand or is lighter in color and thinner than is typical. Also, in places the carbonates are leached and the subsoil has more clay.

Included with these soils in mapping are small areas of Oglala and Vetal soils, outcrops of sandstone bedrock, and outcrops of gravel. Oglala soils have less sand and are in similar positions on the landscape. The Vetal soils are gently sloping and have a darker surface layer that is more than 20 inches thick. They are in small depressions and concave areas. Outcrops of sandstone are on narrow ridgetops and sharp slope breaks. Outcrops of gravel are on small knolls at higher elevations. The included soils and the outcrop areas make up 10 to 20 percent of the map unit.

Permeability of these soils is moderately rapid. Runoff is medium. The available water capacity of the Tassel soil is very low, and that of the Busher soil is moderate. The organic matter content of the Tassel soil is low, and that of the Busher soil is moderately low. The root zone of the Tassel soil is shallow, and that of the Busher soil is deep.

Nearly all of the acreage of these soils is in native grasses and is used as rangeland. There are a few scattered areas of trees.

These soils are not suited to use as farmland because of the steep slopes and the shallow root zone of the Tassel soil.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants on the steeper slopes.

These soils are generally not suited to trees and shrubs in windbreaks because the Tassel soil is shallow and both soils are steep.

The Busher soil is suited to wild herbaceous plants and shrubs that provide food and cover for rangeland wildlife. The Tassel soil is poorly suited.

Figure 12.—Rangeland in an area of Tassel loamy very fine sand, 20 to 50 percent slopes.

These soils generally are not suited to sanitary facilities or to use as building sites because of the steep slopes and the shallow depth to bedrock of the Tassel soil. A suitable alternate site should be considered. Cuts and fills are generally needed to provide suitable grades for roads. The shallowness of the Tassel soil must be considered where cuts are needed for roads.

These soils are assigned to capability unit VIs-4 dryland. Tassel soil is in the Shallow Limy range site, and the Busher soil is in the Sandy range site. These soils are in windbreak suitability group 10.

TcG—Tassel-Busher-Rock outcrop complex, 11 to 60 percent slopes. This map unit consists of steep and very steep, excessively drained and somewhat excessively drained soils and rock outcrops on uplands. The Tassel soil is shallow. It is on narrow ridgetops and on the upper part of dissected side slopes. The Busher soil is deep. It is on side slopes that are typically less than 30 percent. Tassel and Busher soils formed in material that weathered from fine-grained sandstone. The outcrops of rock are on ridgetops and on the upper part of side slopes. The areas of this map unit range from 20 to 240 acres in size. The Tassel soil makes up 40 to 60 percent of the areas, the Busher soil makes up 20 to 30 percent, and Rock outcrop makes up 10 to 20 percent.

Typically, the Tassel soil has a surface layer of pale brown, very friable, calcareous very fine sandy loam about 7 inches thick. The underlying material is very pale brown, calcareous fine sandy loam. White, weakly cemented, limy sandstone is at a depth of 15 inches. In some places the soil is finer textured than is typical. Also, in places there is coarse sand at a depth of 15 inches to a depth of more than 60 inches.

Typically, the Busher soil has a surface layer of grayish brown, very friable very fine sandy loam about 7 inches thick. The subsurface layer is brown, very friable very fine sandy loam about 8 inches thick. The subsoil is pale brown, very friable very fine sandy loam about 14 inches thick. The underlying material is very pale brown very fine sandy loam. Bedrock, is at a depth of 54 inches and extends to a depth of 60 inches or more. It is very pale brown, weakly cemented, fine-grained sandstone. In some places the surface layer is coarser textured than is typical. Also, in places the surface layer is pale brown. In places very gravelly coarse sand is at a depth of 40 inches and extends to a depth of 60 inches or more.

Typically, the Rock outcrop is fine-grained, limy sandstone. Thin to thick layers of strongly cemented sandstone alternate with layers of weakly cemented sandstone. In some places in relatively lower positions on the landscape there are outcrops of siltstone.

Included in mapping this complex are small areas of Bridget soils and Dix soils. The Bridget soils are deep, have less sand throughout, and do not have sandstone within a depth of 60 inches. They are on foot slopes. The Dix soils are excessively drained. They are shallow over very gravelly coarse sand and are on narrow ridgetops. The included soils make up 5 to 10 percent of the map unit.

Permeability of the Tassel and Busher soils is moderately rapid. Runoff is rapid on the Tassel and Busher soils and very rapid on Rock outcrop. The available water capacity of the Tassel soil is very low, and that of the Busher soil is moderate. The organic matter content of the Tassel soil is low, and that of the Busher soil is moderately low. The root zone is shallow in the Tassel soil.

Nearly all of the acreage of this map unit is in native grasses and savannah vegetation consisting of native grasses interspersed with trees. The use is mainly rangeland.

The Tassel and Busher soils are not suited to farming because of steep slopes, the shallow root zone of the Tassel soil, and the rock outcrops.

The Tassel and Busher soils are suited to use as rangeland, and this use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing also reduces the herbaceous plant cover and increases the shrub and tree cover. Also, the increase in woody plants changes the plant community to shade tolerant grasses that have a poorly developed root system. Consequently, the soils are more susceptible to sheet and gully erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

The soils generally are not suited to trees and shrubs in windbreaks because of the excessive slope and the rock outcrops. Furthermore, the Tassel soil is shallow.

The soils generally are not suited to sanitary facilities or to use as building sites because of the steep and very steep slopes. Alternate sites on other soils should be considered. Extensive cuts and fills are needed to provide a suitable grade for roads. The sandstone bedrock restricts the ease of making cuts and needs consideration in the building of roads.

The soils are assigned to capability unit VIIs-4 dryland. The Tassel soil is in the Shallow Limy range site, and the Busher soil is in the Sandy range site. Both soils are in windbreak suitability group 10. Rock outcrop was not assigned to a range site or a windbreak suitability group.

Tr—Tripp very fine sandy loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It formed in loamy alluvium that in many areas contains a component of loess. It is on broad stream terraces. The areas of this soil typically range from 5 to 350 acres, but one area is 1,700 acres.

Typically, the surface layer is grayish brown, friable very fine sandy loam about 8 inches thick. The subsurface layer is grayish brown, friable loam about 6 inches thick. The subsoil is light brownish gray, friable loam about 11 inches thick. The underlying material is white loam to a depth of 60 inches or more; lime has accumulated in the upper part. In some places the surface soil is more than 20 inches thick. Also, in some places the surface layer is lighter in color than is typical. In places there is no subsoil or layer of accumulated lime.

Included with this soil in mapping are small areas of Alice soils and land-leveled areas of the Tripp soil. Alice soils have less silt and more sand than the Tripp soil; they and the Tripp soil are in similar positions on the landscape. In most of the land-leveled areas of the Tripp soil, the surface layer and all or part of the subsoil have been removed, and calcareous material and some gravel are exposed. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high. The water intake rate for irrigation is moderate. The content of organic matter is moderate. Tilth is good.

Nearly all of the acreage of this soil is farmed. Many areas are irrigated, but some are dry-farmed or used as irrigated pasture.

This soil is suited to dry-farmed winter wheat. The lack of precipitation is the major limitation, although, soil blowing is a hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil increases the content of organic matter and maintains tilth and fertility.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa (fig. 13). Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface and help conserve moisture. A green manure crop and crop residue on the soil improve tilth, the infiltration of water, the content of organic matter, and fertility, especially where the soil has been disturbed by land leveling.

This soil is suited to use as irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Proper stocking rates, pasture rotation, the timely deferment of grazing, and the use of fertilizers help maintain or improve the pasture.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Conventional equipment can be used to cultivate between the tree rows. Using appropriate herbicides in the tree rows also helps control undesirable weeds and grasses. The areas in the tree rows or near small trees can be hoed by hand or roto-tilled. Trees can be planted on the contour to help reduce runoff. Irrigation, by the drip system for example, can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and to dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. Good surface drainage

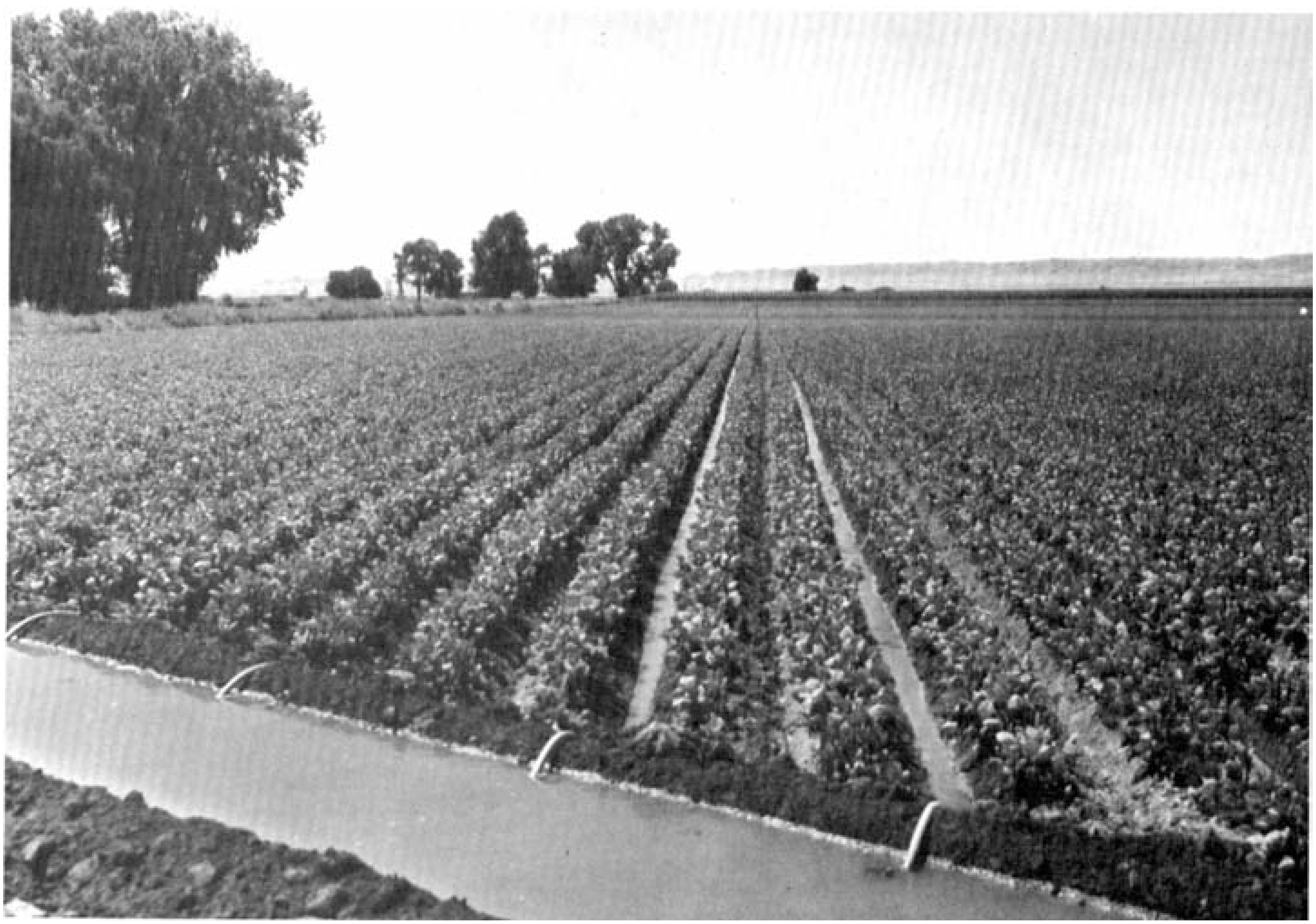


Figure 13.—Gravity irrigation on a field of dry edible beans in an area of Tripp very fine sandy loam, 0 to 1 percent slopes. Some areas of this soil are dry-farmed.

and the use of a gravel moisture barrier in the subgrade can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIc-1 dryland and I-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

TrB—Tripp very fine sandy loam, 1 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in loamy alluvium that in many areas contains a component of loess. The soil is on convex slopes of stream terraces. The areas of this soil range in size from 5 to 200 acres.

Typically, the surface layer is brown, friable very fine sandy loam about 10 inches thick. The subsoil is very friable, very fine sandy loam about 12 inches thick. It is brown in the upper part and pale brown in the lower part. The underlying material extends to a depth of more than 60 inches. It is white and light gray, very fine sandy loam in the upper part, where lime has accumulated, and very pale brown, calcareous very fine sandy loam in the lower part. In some places the surface soil is more than 20 inches thick, or it is lighter in color than is typical. Also, in places there is no subsoil or layer of accumulated lime.

Included with this soil in mapping are small areas of Alice soils and land-leveled areas of the Tripp soil. Alice soils have more sand than the Tripp soil and are in positions on the landscape similar to those of the Tripp soil. In most of the land-leveled areas of the Tripp soil the surface layer and all or part of the subsoil have been removed, and calcareous material and, in some places, gravel are exposed. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate, and runoff is slow. The available water capacity is high. The water intake rate for irrigation is moderate. The content of organic matter is moderate, and tilth is good.

Nearly all the acreage of this soil is farmed. Many areas are irrigated for use as farmland or pasture, but some are dry-farmed.

This soil is suited to dry-farmed winter wheat. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil helps increase the content of organic matter and helps maintain tilth and fertility.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Land leveling increases the efficiency of a gravity irrigation system. Sprinkler irrigation is efficient on this soil. Soil blowing is a slight hazard. Winter cover crops help reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the infiltration of water, the organic matter content, and fertility, especially where the soil has been disturbed by land leveling.

This soil is suited to use as irrigated pasture and grass-legume hayland. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and the use of fertilizer help maintain or improve the pasture.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Cultivating between the tree rows with conventional equipment and using appropriate herbicides in the tree rows help control undesirable weeds and grass. The areas in the tree rows and those areas near small trees can be hoed by hand or roto-tilled. Trees can be planted on the contour to reduce runoff. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally suited to septic tank absorption fields and to dwellings. For sewage lagoons, grading is necessary to modify the slope and shape the lagoon. The lagoons need to be lined or sealed to prevent seepage. Damage to roads by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIe-1 dryland and IIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

TrC—Tripp very fine sandy loam, 3 to 6 percent slopes. This soil is deep, gently sloping, and well drained. It formed in loamy alluvium that in many areas contains a component of loess. The soil is on convex side slopes of stream terraces. The areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 12 inches thick. The subsoil is light brownish gray, friable, and about 15 inches thick. It is very fine sandy loam in the upper part and loam in the lower part. The underlying material is light gray, calcareous loam. Lime has accumulated in the upper part. In some places the surface layer is more than 20 inches thick, or it is lighter in color than is typical. In some places there is no subsoil or layer of accumulated lime.

Included with this soil in mapping are small areas of Alice soils. Alice soils have more sand throughout than the Tripp soil. They and the Tripp soil are in similar positions on the landscape. Also included are some areas of the Tripp soil where land leveling has removed the surface layer and all or part of the subsoil. In these areas, calcareous material and some gravel are exposed. The included soils and land-leveled areas make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this soil is used as irrigated or dry farmland. A few small areas are in native grasses and are used as rangeland.

This soil is suited to dry-farmed winter wheat. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Terraces can be installed to help reduce water erosion. Returning crop residue to the soil improves the organic matter content and helps maintain tilth and fertility.

Under sprinkler irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the infiltration of water, the organic matter content, and fertility, especially where the soil has been disturbed by land leveling operations.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Cultivating between the tree rows with conventional equipment and using appropriate herbicides in the tree rows can help control undesirable weeds and grass. The areas around the small trees can be hoed by hand or roto-tilled. Trees planted on the contour help reduce erosion and the runoff of water. Irrigation can provide supplemental water during periods of low rainfall. The drip system is commonly used.

This soil is generally suited to septic tank absorption fields and to dwellings. For sewage lagoons, grading is necessary in order to modify the slope and shape the lagoon. In addition, the lagoons need to be lined or sealed to prevent seepage. Good surface drainage can reduce damage to roads by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIe-1 dryland and IIIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

TrC2—Tripp very fine sandy loam, 3 to 6 percent slopes, eroded. This soil is deep, gently sloping, and well drained. It formed in loamy alluvium that in many areas contains a component of loess. It is on convex side slopes of stream terraces. The areas of this soil range from 5 to 75 acres.

Typically, the surface layer is grayish brown, friable very fine sandy loam. Erosion has thinned the surface layer to about 5 inches. In some places, tillage has mixed the upper part of the subsoil with the remaining surface layer. The subsoil, which is about 9 inches thick, is friable very fine sandy loam. It is brown in the upper part and pale brown in the lower part. The underlying material which extends to a depth of more than 60 inches, is white very fine sandy loam in the upper part, where lime has accumulated; very pale brown very fine sandy loam in the middle part; and very pale brown fine sandy loam in the lower part. In some places the surface layer is grayish brown loam and is more than 10 inches thick, or it is lighter in color than is typical. In places there is no subsoil and no layer of accumulated lime.

Included with this soil in mapping are small areas of Alice soils, calcareous soils, and land-leveled areas. Alice soils have more sand throughout than the Tripp soil and are in positions on the landscape similar to those of the Tripp soil. The calcareous soils are on convex slopes. In the land-leveled areas, the surface layer and all or part of the subsoil have been removed, exposing the underlying calcareous material and, in some places, gravel. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high. The water intake rate for irrigation is moderate. The content of organic matter is moderately low, and tilth is good.

Most of the acreage of this soil is used as farmland, which is both irrigated and dry-farmed. A few small areas are in native grasses and used as rangeland.

This soil is suited to dry-farmed winter wheat. Soil blowing and water erosion are moderate hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Terraces can be installed to help prevent water erosion. Returning crop residue to the soil increases the content of organic matter, improves fertility, and maintains tilth.

Under sprinkler irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of slope. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Using a green manure crop and returning crop residue to the soil improve tilth, the infiltration of water, the organic matter content, and fertility, especially where the soil has been disturbed by land leveling.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing also can result in soil loss by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Cultivating between the tree rows with conventional equipment and using appropriate herbicides in the tree rows help control undesirable weeds and grasses. The areas around the small trees can be hoed by hand or roto-tilled. Trees planted on the contour help reduce erosion and runoff. Drip irrigation can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and to dwellings. For sewage lagoons, grading is necessary in order to modify the slope and shape the lagoon. The lagoons need to be lined or sealed to prevent seepage. It is necessary either to design small commercial buildings to accommodate the slope or to grade the slope to an acceptable gradient. Damage to roads and streets caused by frost action can be reduced by providing good surface drainage. Crowning the roads and streets by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIe-8 dryland and IIIe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

TrD—Tripp very fine sandy loam, 6 to 9 percent slopes. This soil is deep, strongly sloping, and well drained. It formed in loamy alluvium that in many areas contains a component of loess and is on convex side slopes of stream terraces. The areas of this soil range from 6 to 200 acres.

Typically, the surface layer is grayish brown, friable very fine sandy loam about 11 inches thick. The subsoil, which is calcareous in the lower part, is pale brown, friable very fine sandy loam about 19 inches thick. The underlying material, which extends to a depth of more than 60 inches, is very pale brown and light gray very fine sandy loam in the upper part, where lime has accumulated, and very pale brown in the lower part. In some places the surface layer is lighter in color than is typical. Also, in places there is no subsoil and no layer of accumulated lime.

Included with this soil in mapping are small areas of Dix and Duroc soils. Dix soils are shallow to very gravelly loamy coarse sand. They and the Tripp soil are in similar positions on the landscape. The Duroc soils are gently sloping and have a surface soil that is more than 20 inches thick. They are on foot slopes. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate, and runoff is medium. The available water capacity is high. The water intake rate for irrigation is moderate. The content of organic matter is also moderate. Tilth is good.

Most of the acreage of this soil is irrigated farmland or dryfarmland. A few small areas are used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil increases the organic matter content and maintains tilth and fertility.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of excessive slopes. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil increases the organic matter content, and maintains tilth and fertility.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Trees can be planted on the contour to help reduce erosion and the excessive runoff of water. Cultivating between the tree rows with conventional equipment and using herbicides in the tree rows help control undesirable weeds and grasses. The areas in the tree rows or around the small trees can be hoed by hand or roto-tilled. The drip system of irrigation is one efficient method of providing supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and to dwellings. For sewage lagoons, extensive grading is necessary to modify the slope and shape the lagoon. The lagoons need to be lined or sealed to prevent seepage. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IVe-1 dryland and IVe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

TrD2—Tripp very fine sandy loam, 6 to 9 percent slopes, eroded. This soil is deep, strongly sloping, and well drained. It formed in loamy alluvium that in many areas contains a component of loess. The soil is on convex side slopes of stream terraces. The areas of this soil range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam, about 7 inches. In places, tillage has mixed the upper part of the subsoil with the remaining surface layer. The subsoil is light brownish gray, very friable loam about 7 inches thick. The underlying material extends to a depth of 60 inches or more. It is pale brown fine sandy loam in the upper part, where lime as accumulated, very pale brown loam in the middle part, and very pale brown sandy loam in the lower part. In some places the surface layer is grayish brown loam more than 10 inches thick. Also, in places the surface layer is sandy loam or is lighter in color than is typical. In places there is no subsoil or a layer of accumulated lime.

Included with this soil in mapping are small areas of Dix and Duroc soils, land-leveled areas, and outcrops of gravel and bedrock. Dix soils are shallow over very gravelly loamy coarse san. They and the Tripp soil are in similar positions on the landscape. The Duroc soils are gently sloping and have a surface soil that is more than 20 inches thick. They are on foot slopes. In the land-leveled areas of the Tripp soil the surface layer and all or part of the subsoil have been removed, exposing the underlying calcareous material and, in some places, gravel. The outcrops of gravel and bedrock are on the higher parts of side slopes and sharp slope breaks. The included soils make up about 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is medium. The available water capacity is high, and the water intake rate for irrigation is moderate. The content of organic matter is moderately low. Tilth is good.

Most of the acreage of this soil is either dry-farmed or used as irrigated farmland. A few small areas are in native grasses and used as rangeland.

This soil is poorly suited to dry-farmed crops, including winter wheat. Soil blowing and water erosion are severe hazards if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil increases the organic matter content, improves fertility, and maintains tilth.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The efficient management of irrigation water is a concern because of the slope. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. A green manure crop and crop residue on the soil improve tilth, the infiltration of water, the organic matter content, and fertility, especially where the soil has been disturbed by land leveling operations.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding may be needed where the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive if competing vegetation is controlled or removed by good site preparation. Trees can be planted on the contour to help reduce erosion and excessive runoff of water. Cultivating between the tree rows with conventional equipment and using appropriate herbicides in the tree rows help control undesirable weeds and grasses. The areas around small trees can be hoed by hand or roto-tilled. Irrigation, by the drip system for example, can provide supplemental water during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and to dwellings. For sewage lagoons, extensive grading is required to modify the slope and shape the lagoon. The lagoons need to be lined or sealed to prevent seepage. Damage to roads caused by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IVe-8 dryland and IVe-6 irrigated. It is in the Silty range site and in windbreak suitability group 3.

VaD—Valent fine sand, 3 to 9 percent slopes. This soil is deep, gently sloping and strongly sloping, and excessively drained. It formed in eolian sands on hummocks on stream terraces and upland side slopes. The areas range from 5 to 200 acres in size.

Typically, the surface layer is pale brown, loose fine sand about 8 inches thick. The underlying material is pale brown sand to a depth of more than 60 inches. In some places carbonates are within a depth of 40 inches. Also, in places the surface layer is darker than is typical.

Included with this soil in mapping are small areas of Els and Wildhorse soils. Els and Wildhorse soils are somewhat poorly drained, have a seasonal high water table, and are in lower positions on the landscape than the Valent soil. Wildhorse soils are strongly alkaline. The included soils make up 5 to 10 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low, and the water intake rate for irrigation is very high. The content of organic matter is low. Tilth is fair.

Most of the acreage of this soil is in native grasses and is used as rangeland. Some areas are used as farmland irrigated by a sprinkler system.

This soil is generally not suited to dryland farming. Soil blowing and droughtiness are very severe hazards.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn and alfalfa. Soil blowing is a very severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage, for example, disc or chisel and plant, no-till plant, and till plant, keeps crop residue on the surface, controls soil blowing, and conserves moisture. Irrigation water has to be applied at regular intervals because of the low available water capacity of the soil. Crop residue on the soil helps improve tilth and fertility and increases the content of organic matter.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing and in blowouts. Proper grazing use, timely deferment of grazing or haying, and a planned grazing sytem help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled by good site preparation. It is necessary to plant trees in a shallow furrow with as little disturbance to the soil as possible. Maintaining sod between the tree rows and in the tree rows helps. Areas near the trees can be hoed by hand. Supplemental water, irrigation by the drip system for example, may be needed during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity can result in pollution of underground water. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. The soil is generally suited to dwellings and roads. Reseeding native grasses in a protective cover helps reduce soil blowing on graded roadsides.

This soil is assigned to capability units VIe-5 dryland and IVe-12 irrigated. It is in the Sands range site and in windbreak suitability group 7.

VaE—Valent fine sand, rolling. This soil is deep, rolling, and excessively drained. It formed in eolian sands. It is on smooth convex slopes on dunes, on stream terraces, and uplands. The slope typically ranges from 9 to 17 percent. The areas of this soil range from 5 to over 640 acres in size.

Typically, the surface layer is grayish brown, loose fine sand aout 5 inches thick. A transitional layer is light brownish gray, loose fine sand about 6 inches thick. The underlying material is light brownish gray sand to a depth of more than 60 inches. In some places, carbonates are within a depth of 40 inches. Also, in some places the surface layer is darker than is typical, and the soil has more silt and less sand.

Included with this soil in mapping are small areas of Dailey soils. Dailey soils have a dark surface layer that is thicker than that of the Valent soil. They are on concave slopes and are lower on the landscape than the Valent soil. They make up 5 to 10 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low. The content of organic matter is low.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland.

This soil is generally not suited to use as cropland because of moderately steep slopes and the very severe hazards of soil blowing and droughtiness.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes the native plants to deteriorate. Overgrazing results in severe losses by soil blowing and in the formation of small blowouts. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

This soil is poorly suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. It is necessary to plant trees in a shallow furrow or a roto-tilled strip with as little disturbance of the soil as possible. Sod should be maintained between the tree rows and in the tree rows. The areas near the trees can be hoed by hand. Supplemental water, which can be provided by the drip system of irrigation, may be needed during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not readily filter the effluent. The poor filtering capacity can result in pollution of underground water. Sewage lagoons need to be lined or sealed to prevent seepage, and extensive grading is necessary to modify the slope and shape the lagoon. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. It is necessary to design dwellings to accommodate the slope, or the slope can be graded. Cuts and fills are generally needed to provide a suitable grade for roads. Reseeding native grasses in a protective cover helps reduce soil blowing on graded roadsides.

This soil is assigned to capability unit VIe-5 dryland. It is in the Sands range site and in windbreak suitability group 7.

VaF—Valent fine sand, rolling and hilly. This map unit consists of deep, excessively drained soils that formed in eolian sand on stream terraces. Valent fine sand, rolling, is on smooth convex slopes on dunes. Valent fine sand, hilly, is on the irregular steeper slopes on dunes that in some places have a catstep surface. The slope range is 11 to 50 percent.

The areas of this map unit range from 30 to more than 640 acres in size. The rolling Valent soil makes up 30 to 60 percent of each mapped area, and the hilly Valent soil makes up 25 to 50 percent. The soils are in such an intricate pattern that it was not practical to map them separately.

Typically, the rolling Valent soil has a surface layer of grayish brown, loose fine sand about 1 inch thick. The subsurface layer is brown, loose fine sand about 5 inches thick. The underlying material is sand to a depth of more than 60 inches. It is pale brown in the upper part and very pale brown in the lower part. In some places, there are carbonates within a depth of 40 inches.

Typically, the hilly Valent soil has a surface layer of brown, loose fine sand about 4 inches thick. The underlying material is pale brown sand to a depth of more than 60 inches.

Included with these soils in mapping are small areas of Dailey soils. Dailey soils have a darker and thicker surface layer than that of the Valent soils. Dailey soils are on concave slopes that are lower on the landscape than the Valent soils. Dailey soils make up 5 to 10 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low, and the content of organic matter is low.

Nearly all of the acreage of these soils is in native grasses and is used as rangeland.

These soils are not suited to farming use because of steep and very steep slopes and the very severe soil blowing hazard.

These soils are suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes the native plants to deteriorate. Overgrazing results in severe losses by soil blowing, which causes blowouts. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

The soils generally are not suited to trees and shrubs in windbreaks. Onsite investigation is necessary to determine whether or not limited sites are suitable.

The soils generally are not suited to sanitary facilities because of excessively steep slopes. A suitable alternate site should be considered for this purpose. On the rolling soil, dwellings should be properly designed to accommodate the slope or the soil should be graded to an acceptable gradient. The hilly soil is not suitable for building site development because of the excessively steep slopes. Cuts and fills generally are needed to provide a suitable grade for roads. Reseeding native grasses in a protective cover helps reduce soil blowing on graded roadsides.

These soils are assigned to capability unit VIIe-5 dryland and .windbreak suitability group 10. The rolling Valent soil is in the Sands range site, and the hilly Valent soil is in the Choppy Sands range site.

VdB—Valent loamy fine sand, 0 to 3 percent slopes. This soil is deep, very gently sloping, and excessively drained. It formed in eolian sand and is on low hummocks on stream terraces and uplands. The areas of this soil range from 5 to 450 acres in size.

Typically, the surface layer is pale brown, very friable loamy fine sand about 10 inches thick. A transitional layer is pale brown, very friable loamy fine sand about 8 inches thick. The underlying material is very pale brown loamy fine sand to a depth of 60 inches or more. In some places, carbonates are within a depth of 40 inches. Also, in places the surface layer is darker than is typical.

Included with this soil in mapping are small areas of Els, Jayem, Sarben, and Vetal soils. The Els soils are somewhat poorly drained and have a seasonal high water table. They are lower on the landscape than the Valent soil. The Jayem and Sarben soils are loamy, have less sand, and are in similar positions on the landscape. The Vetal soils have a darker and thicker surface layer and are on concave slopes in lower positions on the landscape. The included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow, and the available water capacity is low. The water intake rate for sprinkler irrigation using ground water is very high, and the rate for gravity irrigation using canal water is moderately high. The content of organic matter is low. Tilth is fair.

Most of the acreage of this soil is in native grasses and used as rangeland. Some areas are farmed, generally under irrigation.

This soil is generally not suited to dryland farming. Soil blowing and droughtiness are very severe hazards.

Under irrigation, this soil is poorly suited to crops, including corn and alfalfa. A sprinkler system of irrigation is most efficient on this soil. Soil blowing is a very severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Irrigation water has to be applied at regular intervals because of the low available water capacity of the soil. A green-manure crop and crop residue on the soil improve tilth, the water intake rate, fertility, and the content of organic matter, especially where the soil has been disturbed by land leveling operations.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing results in severe losses by soil blowing and in small blowouts. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Range seeding can establish a protective vegetative cover where the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by appropriate herbicides. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Inadequate rainfall is the principal limitation to consider when planting trees. Supplemental water may be needed during periods of low rainfall. A drip system of irrigation can be used to provide the water.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not filter the effluent adequately. The poor filtering capacity can result in pollution of underground water. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. This soil generally is suited to dwellings, buildings, roads, and streets. Reseeding native grasses in a protective cover helps reduce soil blowing in the graded areas of roadsides.

This soil is assigned to capability units VIe-5 dryland, IVe-11 where irrigated by a sprinkler system, and IVe-8 where irrigated by a gravity system. The soil is in the Sandy range site and in windbreak suitability group 7.

VdD—Valent loamy fine sand, 3 to 9 percent slopes. This soil is deep, gently sloping and strongly sloping, and excessively drained. It formed in eolian sand and is on hummocks on stream terraces and uplands. The areas of this soil range from 10 to 400 acres in size.

Typically, the surface layer is brown, very friable loamy fine sand about 6 inches thick. A transitional layer is brown, very friable fine sand about 10 inches thick. The underlying material is fine sand to a depth of more than 60 inches. It is pale brown in the upper part and very pale brown in the lower part. In some places, carbonates are within a depth of 40 inches. Also, in places the surface layer is darker than is typical and has more very fine sand and silt.

Included with this soil in mapping are small areas of Jayem and Vetal soils. Jayem soils are loamy. They and the Valent soil are in similar positions on the landscape. Vetal soils have a darker and thicker surface layer than that of the Valent soil. Vetal soils are on concave slopes in lower positions on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low, and the water intake rate for irrigation is very high. The content of organic matter is low. Tilth is fair.

Most of the acreage of this soil is in native grasses and used as rangeland. In a few small areas, this soil is farmed under irrigation.

This soil generally is not suited to dry-farmed crops. Soil blowing and droughtiness are severe hazards.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn and alfalfa. Where it is strongly sloping this soil is best suited to alfalfa and other closely sowed crops. Soil blowing is a severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Irrigation water has to be applied at regular intervals because of the low available water capacity. Returning crop residue to the soil improves tilth and fertility and increases the content of organic matter.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause the native plants to deteriorate. Overgrazing can result in severe losses by soil blowing and in small blowouts. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

Range seeding may be needed where the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. It is necessary to plant trees in a shallow furrow or a roto-tilled strip with as little disturbance of the soil as possible. Sod should be maintained between the tree rows and in the tree rows. The areas near the trees can be hoed by hand. During periods of low rainfall, supplemental water can be provided by irrigation. The drip system is commonly used.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not filter the effluent adequately. The poor filtering capacity can result in pollution of underground water. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. This soil generally is suited to dwellings and roads. Reseeding native grasses in a protective cover helps reduce soil blowing on graded roadsides.

This soil is assigned to capability units VIe-5 dryland and IVe-11 irrigated. It is in the Sands range site and in windbreak suitability group 7.

VnD—Valentine fine sand, 3 to 9 percent slopes. This soil is deep, sloping, and excessively drained. It is on hummocks in sandhills and formed in eolian sand. The areas of this soil, typically, range from 80 to 275 acres in size. A few areas are as small as 5 acres.

Typically, the surface layer is grayish brown, loose fine sand about 8 inches thick. A transitional layer is grayish brown, loose fine sand about 6 inches thick. The underlying material, which extends to a depth of more than 60 inches, is light brownish gray fine sand. In some places the depth to free carbonates is less than 40 inches.

Included with this soil in mapping are small areas of Dunday, Els, and Wildhorse soils. The Dunday soils are somewhat excessively drained, have a darker and thicker surface layer than that of the Valentine soil, and are in depressions and on foot slopes. Els and Wildhorse soils are somewhat poorly drained, have a seasonal high water table, and are lower on the landscape than the Valentine soil. In addition, the Wildhorse soils are strongly alkaline. The included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low, and the water intake rate for irrigation is very high. The organic matter content is low. Tilth is fair.

Most of the acreage of this soil is in native grasses and used as rangeland and hayland. Some areas are farmed, mainly under irrigation.

This soil is not suited to dry-farmed crops. Soil blowing is a very severe hazard.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn and alfalfa. Soil blowing is a very severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. The application of irrigation water has to be regulated to accommodate the low available water capacity of the soil. Crop residue on the soil helps improve tilth and fertility and increases the content of organic matter.

This soil is suited to use as rangeland, a use that effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Overgrazing can result in severe losses by soil blowing and in small blowouts. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants. Range seeding may be needed where the land use is changed from cropland to rangeland.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation, such as planting the trees in a shallow furrow or in a narrow roto-tilled strip with as little disturbance of the soil as possible. Sod should be maintained between the tree rows. The areas near the trees can be hoed by hand. Irrigation, by the drip system, can provide supplemental water during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity can result in pollution of underground water. Sewage lagoons need to be lined or sealed to prevent seepage. This soil generally is suited to dwellings and local roads. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. Reseeding native grasses in a protective cover helps reduce soil blowing on graded roadsides.

This soil is assigned to capability units VIe-5 dryland and IVe-12 irrigated. It is in the Sands range site and in windbreak suitability group 7.

VnE—Valentine fine sand, rolling. This soil is deep, rolling, and excessively drained. It is on smooth convex slopes on dunes in sandhills and formed in eolian sand. The slope typically ranges from 9 to 17 percent. The areas range from 80 to more than 640 acres in size.

Typically, the surface layer is light brownish gray, loose fine sand about 5 inches thick. A transitional layer is very pale brown, loose fine sand about 10 inches thick. The underlying material is very pale brown fine sand to a depth of more than 60 inches. In some places the depth to free carbonates is less than 40 inches.

Included with this soil in mapping are small areas of Dunday, Els, and Tassel soils. The Dunday soils are gently sloping to strongly sloping, have a darker and thicker surface layer, and are at lower elevations. The Els soils are somewhat poorly drained, have a seasonal high water table, and are at lower elevations also. Tassel soils are in small scattered areas where the sand mantle is thin or missing. The included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low, and the content of organic matter also is low.

Nearly all of the acreage of this soil is in native grasses and used as rangeland (fig. 14).

This soil is generally not suited to use as farmland because of the moderately steep slopes and the very severe soil blowing hazard.

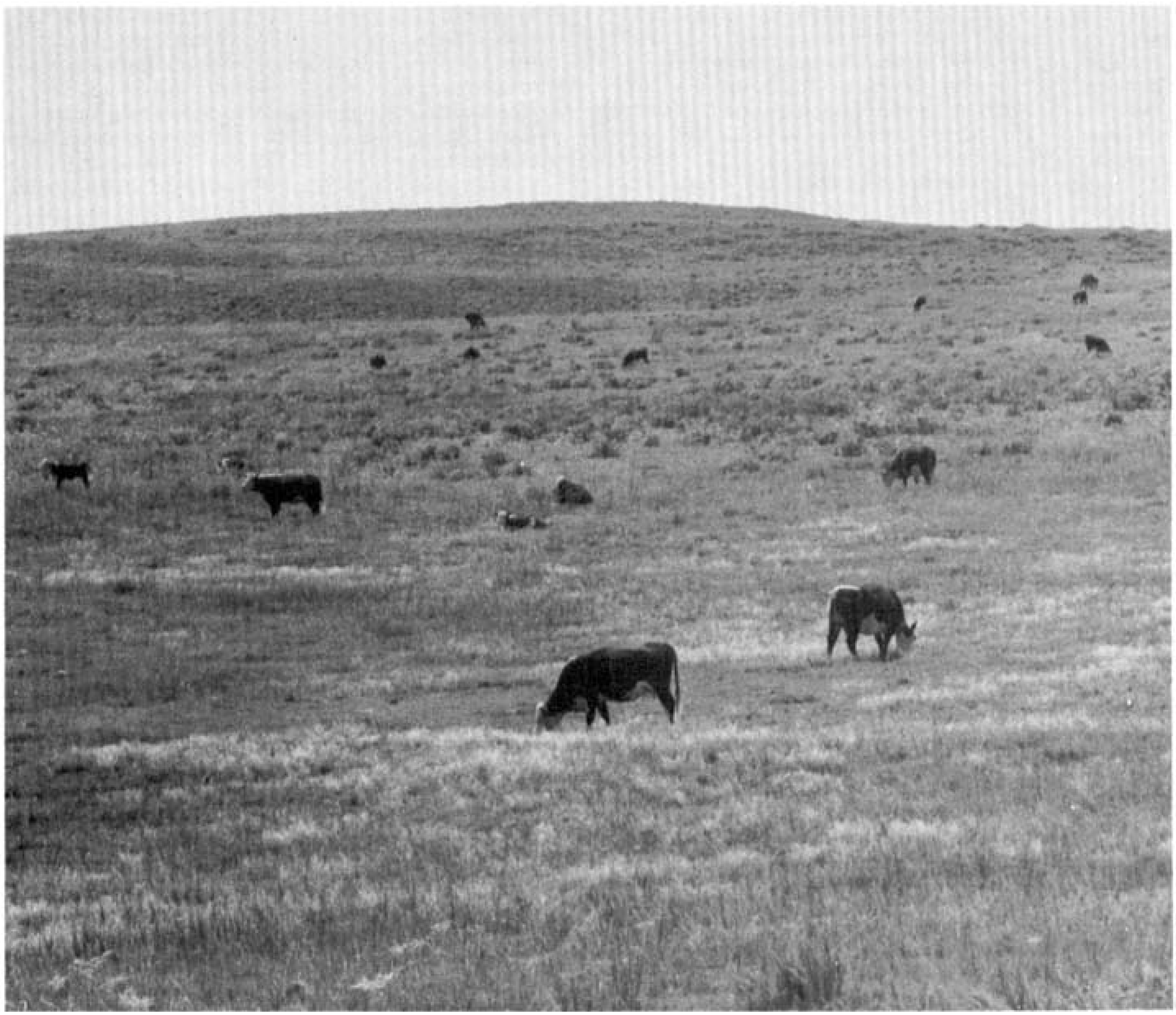


Figure 14.—Rangeland in an area of Valentine fine sand, rolling.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes the native plants to deteriorate. It can result in severe losses by soil blowing and in small blowouts. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation, for example, planting the trees in a shallow furrow or a narrow roto-tilled strip with as little disturbance of the soil as possible. Maintaining sod between the tree rows also helps. The areas near the trees can be hoed by hand. Irrigation, by the drip system for example, can provide supplemental water during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not filter the effluent readily. The poor filtering capacity can result in the pollution of underground water. For sewage lagoons, extensive grading is required to modify the slope and shape the lagoon. Sewage lagoons need to be lined or sealed to prevent seepage. Dwellings need to be designed to accommodate the slope, or the soil needs to be graded to an acceptable gradient. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. Cuts and fills are generally needed to provide a suitable grade for roads and streets. Reseeding native grasses in a protective cover helps reduce soil blowing on graded roadsides.

This soil is assigned to capability unit VIe-5 dryland. It is in the Sands range site and in windbreak suitability group 7.

VnF—Valentine fine sand, rolling and hilly. This map unit consists of deep, excessively drained soils on sandhills. These soils formed in eolian sand. The slope ranges typically from 9 to 40 percent. The areas of this map unit range in size from 80 to more than 640 acres, although a few areas are as small as 25 acres. The areas consist of 30 to 60 percent rolling Valentine soil and 25 to 50 percent hilly Valentine soil. The rolling soil is on smooth convex slopes on dunes. The hilly soil is on the irregular steeper and choppy slopes on dunes that, in some places, have a catstep surface. These soils are in such an intricate pattern that it was not practical to map them separately.

Typically, the Valentine soils have a surface layer of light brownish gray, loose fine sand about 2 inches thick. A transitional layer is light brownish gray, loose fine sand about 8 inches thick. To a depth of more than 60 inches, the underlying material is fine sand. It is pale brown in the upper part and very pale brown in the lower part. In some places, free carbonates are within 40 inches of the surface. Typically, the surface layer of the hilly soil is slightly thinner.

Included with these soils in mapping are small areas of Dunday and Els soils and blowouts where the pale brown and very pale brown fine sand has no vegetative cover and is shifted by the winds. The Dunday soils are gently sloping to strongly sloping, have a darker and thicker surface layer than that of the Valentine soils, and are in depressions and on foot slopes. The Els soils are somewhat poorly drained and have a seasonal high water table. They are at lower elevations than the Valentine soils. The blowouts are in concave dished-out areas on side slopes and the top of dunes. The wind erodes these areas easily, and vegetation is difficult to establish. The included areas make up 5 to 10 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low, and the content or organic matter is also low.

Nearly all of the acreage of these soils is in native grasses and used as rangeland.

These soils are not suited to use as farmland because of slope, soil blowing, and difficult access.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover, causes the native plants to deteriorate, and results in severe losses by soil blowing and in the formation of blowouts. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition. Brush management may be needed to control undesirable woody plants.

The soils generally are not suited to trees and shrubs in windbreaks because of the steep and choppy slopes. Onsite investigation of less sloping areas may identify some suitable sites for windbreaks.

These Valentine soils generally are not suited to sanitary facilities because of the steep slopes and the poor filtering capacity of the soils. A suitable alternate site should be considered. On the rolling soil, dwellings need to be designed to accommodate the slope or the slope needs to be graded. The hilly soil is not suitable for building site development because of excessively steep slopes. Cuts and fills generally are needed to provide a suitable grade for roads. Reseeding native grasses in a protective cover helps reduce soil blowing on graded roadsides.

These soils are assigned to capability unit VIIe-5 dryland and windbreak suitability group 10. The rolling soil is in the Sands range site, and the hilly soil is in the Choppy Sands range site.

VnG—Valentine fine sand, hilly. This soil is deep and excessively drained. It is on irregular and choppy slopes on dunes that, in some places, have a catstep surface. The soil formed in eolian sand on sandhills. The slope ranges from 30 to 60 percent. The areas range in size from 80 to more than 640 acres.

Typically, the surface layer is grayish brown, very friable fine sand about 1 inch thick. The subsurface layer is light brownish gray, very friable fine sand about 3 inches thick. A transitional layer is pale brown, loose fine sand about 4 inches thick. To a depth of 60 inches or more, the underlying material is very pale brown fine sand.

Included with this soil in mapping are small areas of Dunday soils and blowouts of pale brown fine sand. The Dunday soils are gently sloping to strongly sloping. They have a darker and thicker surface layer than that of the Valentine soil and are in depressions and on foot slopes. The blowouts of pale brown fine sand are in concave dished-out areas on side slopes and the top of dunes. The wind easily erodes these areas, and vegetation is difficult to establish. The included soils make up less than 5 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low, and the content of organic matter is low. Nearly all of the acreage of this soil is in native grasses and used as rangeland.

This soil is not suited to use as farmland because of the very steep slopes, soil blowing, and difficult access.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock reduces the protective cover, causes the native plants to deteriorate, and results in severe losses by soil blowing and in the formation of blowouts. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

This soil generally is not suited to trees and shrubs in windbreaks, because the soil is very steep and choppy.

This soil generally is not suitable for sanitary facilities because of the very steep slopes and because seepage can contaminate the underground water. A suitable alternate site should be considered. This soil is not suitable for building site development because of very steep slopes. A suitable alternate site should be considered. Cuts and fills generally are needed to provide a suitable grade for roads. Reseeding native grasses in a protective cover is helpful in reducing soil blowing on graded roadsides.

This soil is assigned to capability unit VIIe-5 dryland. It is in the Choppy Sands range site and in windbreak suitability group 10.

VtB—Vetal fine sandy loam, 0 to 3 percent slopes. This soil is deep, very gently sloping, and well drained. It formed in local loamy alluvium. It is in closed swales and on alluvial fans. Its surface is concave or flat. The areas of this soil are elongated in shape and range from 5 to 90 acres.

Typically, the surface layer is grayish brown, friable fine sandy loam about 24 inches thick. A transitional layer is brown, friable fine sandy loam about 17 inches thick. The underlying material is pale brown fine sandy loam to a depth of more than 60 inches. In some places the surface layer, the transitional layer, and the underlying material are finer textured than is typical. Also, in places the surface layer is thinner and there is a subsoil.

Included with this soil in mapping are small areas of Valent soils. The Valent soils have a thinner surface layer that is lighter in color. They are in higher positions on the landscape. The included soils make up less than 5 percent of the map unit.

Permeability is moderately rapid, and runoff is slow. The available water capacity is moderate, and the water intake rate for irrigation is moderately high. The content of organic matter is moderate. Tilth is good.

Most of the acreage of this map unit is used as farmland, which is both irrigated and dry-farmed. A few areas are in native grasses and used as rangeland.

This soil is suited to dry-farmed winter wheat and millet. Soil blowing is a moderate hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as eco-fallow and stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil increases the organic matter content and fertility and maintains tilth.

Under sprinkler irrigation, this soil is suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. Soil blowing is a slight hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Crop residue on the soil increases the organic matter content and fertility and maintains tilth.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate drought moderately well. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation and by applying appropriate herbicides in the tree rows. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation, generally, must be restricted to the tree rows. Supplemental water, irrigation by the drip system for example, may be needed during periods of low rainfall.

This soil is generally suited to septic tank absorption fields and to dwellings. It is necessary to line or seal sewage lagoons to prevent seepage. Good surface drainage can reduce damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIIe-3 dryland and IIe-8 irrigated. It is in the Sandy range site and in windbreak suitability group 5.

Wb—Wildhorse sand, 0 to 2 percent slopes. This is a deep, nearly level, somewhat poorly drained, saline-alkali soil that formed in eolian sand. It is on concave slopes and on low, slightly hummocky slopes in enclosed sandhill valleys. It is subject to rare flooding. The areas of this soil range from 5 to 150 acres in size. One area, however, is 600 acres.

Typically, the surface layer is grayish brown, very friable sand about 4 inches thick. The subsurface layer is light brownish gray, very friable sand about 3 inches thick. The surface layer is strongly alkaline, and the subsurface layer is very strongly alkaline. A transitional layer is light brownish gray, very friable sand about 3 inches thick. It is very strongly alkaline. The underlying material extends to a depth of more than 60 inches. It is light brownish gray sand in the upper part, light gray sand in the middle part, and light gray fine sand in the lower part. It is very strongly alkaline in the upper and middle parts and strongly alkaline in the lower part. In some places the subsoil is finer textured than is typical.

Included with this soil in mapping are small areas of Els, Hoffland, and Valentine soils. Unlike Wildhorse sand, Els, Hoffland, and Valentine soils are not strongly alkaline. Els soils are in about the same positions on the landscape. Hoffland soils are poorly drained and very poorly drained. They are in lower positions on the landscape and are subject to occasional flooding and ponding. Valentine soils are excessively drained and do not have a seasonal high water table. They are on dunes that are higher on the landscape. The included soils make up 5 to 10 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is very low. An apparent seasonal high water table is at a depth that ranges from about 1.5 feet to about 3.5 feet. The organic content is low.

Nearly all of the acreage of this soil is in native grasses and is used as rangeland or hayland.

This soil is not suited to use as farmland because soil blowing is a very severe hazard and the soil is strongly alkaline.

This soil is suited to use as rangeland for either grazing or haying. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is set can cause small mounds to form. The mounds make grazing or harvesting for hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition. The saline-alkali condition of this soil restricts its use to native plants that can tolerate excess salts and strongly alkaline or very strongly alkaline conditions.

This soil is generally not suited to trees and shrubs in windbreaks mainly because of the saline-alkaline conditions. Some small areas may be suitable for trees and shrubs, but onsite investigation is necessary.

This soil is not suited to sanitary facilities because of wetness and the rapid permeability. In addition, it is not suited to dwellings because of flooding and wetness. Suitable alternate sites should be considered for these purposes. Constructing roads on suitable, well-compacted fill material and providing adequate side ditches and culverts help prevent damage to roads from flooding and wetness. Good surface drainage and a gravel moisture barrier in the subgrade can reduce damage to roads caused by frost action. Crowning the roads by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability unit VIs-1 dryland. It is in the Saline Subirrigated range site and in windbreak suitability group 10.

Wc—Wildhorse loamy fine sand, 0 to 2 percent slopes. This alkali soil is deep, nearly level, and somewhat poorly drained. It formed in sandy alluvium on low stream terraces and is subject to rare flooding. The areas of this soil are elongated and range from 5 to 260 acres in size.

Typically, the surface layer is light brownish gray and pale brown, very friable loamy fine sand about 7 inches thick. The underlying material is stratified pale brown, very pale brown, and light gray fine sand and loamy fine sand to a depth of about 39 inches. Below that, to a depth of more than 60 inches, it is stratified light gray, very fine sandy loam. The underlying material is very strongly alkaline. In some places the surface layer is very strongly alkaline. In some places the soil has less sand and more silt than is typical.

Included with this soil in mapping are small areas of Lisco and Valent soils. Lisco soils have a strongly alkaline subsoil; they have less sand than the Wildhorse soil and are in lower positions on the landscape. The Valent soils are excessively drained and sandy. They are free of carbonates to a depth of 40 inches and are higher on the landscape than the Wildhorse soil. The included soils make up 10 to 15 percent of the map unit.

Permeability is rapid. Runoff is slow. The available water capacity is low. The apparent seasonal high water table is at a depth of about 2 to 3.5 feet. The water intake rate for a sprinkler system of irrigation is very high, and that for a gravity system using canal water is moderately high. The content of organic matter is low.

Tilth is fair. This soil has detrimental amounts of sodium and other salts.

This soil is used as irrigated farmland. Where it is in native grasses, it is used as rangeland.

This soil is generally not suited to dryland farming because of the strongly alkaline condition which limits crop growth.

Under sprinkler irrigation, this soil is poorly suited to crops, including corn and alfalfa. The saline-alkali condition of this soil limits the choice of plants and their growth. Soil blowing is a very severe hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, control soil blowing, and conserve moisture. Timely application of irrigation water is necessary because of the low available water capacity of the soil. Returning crop residue to the soil helps improve tilth and fertility and increases the content of organic matter.

This soil is suited to use as rangeland for grazing or haying. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet can cause small mounds to form. The mounds make grazing or harvesting for hay difficult. Proper grazing use, timely deferment of grazing or haying, and restricted use during very wet periods help maintain the native plants in good condition. The saline-alkali condition is a limitation to some native plants.

This soil is generally not suited to trees and shrubs in windbreaks because of the saline-alkali condition.

This soil is not suited to septic tank absorption fields because of flooding and wetness. Sewage lagoons need to be lined or sealed to prevent seepage, diked for protection from flooding, and constructed on fill material that will raise the bottom of the lagoon to a sufficient height above the seasonal high water table. In addition, this soil is not suitable for building site development because of flooding and wetness. Suitable alternate sites should be considered for these purposes. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from floods, wetness, and frost action.

This soil is assigned to capability units VIs-1 dryland, IVs-11 where irrigated by a sprinkler system, and IVs-8 where irrigated by a gravity system. It is in the Saline Subirrigated range site and in windbreak suitability group 10.

Yo—Yockey silt loam, 0 to 1 percent slopes. This soil is deep, nearly level, and somewhat poorly drained. It formed in loamy calcareous alluvium on bottom lands. It is subject to occasional flooding. The areas of this soil range from 5 to 250 acres in size.

Typically, the surface layer is light brownish gray, very friable, calcareous silt loam about 8 inches thick. A transitional layer is light brownish gray, very friable, calcareous loam about 7 inches thick. The underlying material is light brownish gray, calcareous very fine sandy loam in the upper part and stratified light brownish gray and light gray, calcareous very fine sandy loam and silt loam to a depth of more than 60 inches. In some places the surface layer is darker and thicker than is typical, and the soil is finer textured throughout. Also, in places the soil has more sand and less silt.

Included with this soil in mapping are small areas of Craft, Gering, and Janise soils. Craft soils are well drained and are in higher positions on the landscape. Gering soils have gravelly coarse sand at a depth of 20 to 40 inches. Janise soils are more strongly affected by saline-alkali characteristics than the Yockey soil. Gering soils, Janise soils, and the Yockey soil are in similar positions on the landscape. The included soils make up 5 to 15 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high. The apparent seasonal high water table is at a depth that ranges from about 2 feet to about 4 feet. The water intake rate for irrigation is moderate. The content of organic matter is low, and tilth is good.

Most of the acreage of this soil is farmed. Most areas are irrigated, but some are used for dryland farming. A few small areas are in native grasses. They are used as rangeland. A few small areas are used as pasture.

This soil is suited to dry-farmed winter wheat. Soil blowing is a moderate hazard if the surface is not adequately protected by crops or crop residue. Wetness from the seasonal high water table is also a limitation. Planting or tillage in the spring may be delayed because of wetness caused by the seasonal high water table. Conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, help control soil blowing and water erosion, and help conserve moisture. Cover crops also are helpful. Stripcropping helps reduce soil blowing. Returning crop residue to the soil helps to increase the organic matter content and fertility and to maintain tilth.

Under irrigation, this soil is suited to corn, sugar beets, dry edible beans, and alfalfa. Sprinkler irrigation is most efficient on this soil. Wetness is a limitation, and soil blowing is a hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, help keep crop residue on the surface, help control soil blowing, and help conserve moisture. Returning crop residue to the soil helps increase the organic matter content and fertility and helps maintain tilth.

This soil is suited to use as pasture and grass-legume hayland. Irrigation and fertilizer, in amounts based on soil tests, are helpful in maintaining plant vigor and production. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture.

This soil is suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately high water table. Seedlings generally survive if competing vegetation is controlled or removed. This can be accomplished by good site preparation, such as tilling the soil and planting seedlings after the soil has begun to dry, and by timely cultivation between the rows with conventional equipment. Applying appropriate herbicides in the tree rows also is helpful. Irrigation, by the drip system, provides supplemental water during periods of low rainfall when moisture is insufficient.

This soil is not suited to septic tank absorption fields because of flooding and wetness. Sewage lagoons need to be diked for protection from flooding. In addition, they need to be constructed on fill material to raise the bottom of the lagoon to a sufficient height above the seasonal high water table. This soil is not suitable for use as building sites because of flooding and wetness. Alternate sites on other soils that are suited should be considered for these uses. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage from floods and wetness to the road.

This soil is assigned to capability units IIw-4 dryland and IIw-6 irrigated. It is in the Subirrigated range site and in windbreak suitability group 2S.

Yp—Yockey silt loam, alkali, 0 to 1 percent slopes. This alkali soil is deep, nearly level, and somewhat poorly drained. It formed in loamy calcareous alluvium on bottom lands. It is subject to occasional flooding. The areas of this soil range from 5 to 425 acres in size.

Typically, the surface layer is light brownish gray, very friable, calcareous silt loam about 9 inches thick. A transitional layer is pale brown, very friable, calcareous loam about 5 inches thick. The underlying material, which is very fine sandy loam in the upper part and loam in the lower part, is very pale brown and calcareous. It is very strongly alkaline. In places the underlying material is not so strongly alkaline as is typical.

Included with this soil in mapping are small areas of Janise and Lisco soils. Janise and Lisco soils are more strongly affected by saline-alkali characteristics. Their positions on the landscape are similar to those of the Yockey soils. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is moderate. The apparent seasonal high water table is at a depth that ranges from about 2 feet to about 4 feet. The water intake rate for irrigation is moderate. The content of organic matter is low, and tilth is fair. This soil has detrimental amounts of sodium and other salts.

Most of the acreage of this soil is farmed under irrigation; however, a few small areas are dry-farmed. Some of the acreage is used as rangeland, and a few small areas are used as pasture.

This soil is poorly suited to dry-farmed crops, including winter wheat. The saline-alkali characteristics of the soil restrict it to plants that can tolerate excess salts and strongly alkaline conditions. Soil blowing is a severe hazard if the surface is not adequately protected by crops or crop residue. Cover crops and conservation tillage practices, such as stubble mulching, help keep crop residue on the surface, control soil blowing and water erosion, and conserve moisture. Stripcropping helps reduce soil blowing. Crop residue on the soil helps increase the organic matter content, improve fertility, and maintain tilth.

Under irrigation, this soil is poorly suited to crops, including corn, sugar beets, dry edible beans, and alfalfa. The saline-alkali condition limits the intake rate of irrigation water and restricts the growth of crops. A sprinkler system can be used to increase the efficiency of irrigation. Soil blowing is a moderate hazard. A winter cover crop helps reduce soil blowing. Conservation tillage practices, such as disc or chisel and plant, no-till plant, and till plant, keep crop residue on the surface, control soil blowing, and conserve moisture. Returning crop residue to the soil increases the organic matter content and fertility and maintains tilth.

This soil is poorly suited to pasture and grass-legume hayland. Irrigation and fertilizer, applied in amounts based on soil tests help maintain plant vigor and production. Overgrazing by livestock and mowing to an improper height reduce the growth and vigor of the plants. Proper stocking rates, pasture rotation, and timely deferment of grazing help maintain or improve the pasture. The saline-alkali characteristics of this soil limit the use of some plants.

This soil is suited to use as rangeland for grazing or haying, and this use effectively controls soil blowing. Overgrazing, haying at an improper time, and mowing to an improper height reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet can cause small mounds to form. The mounds make grazing or harvesting for hay difficult. Proper grazing use, the timely deferment of grazing or haying, and retricted use during very wet periods help maintain the native plants in good condition. The saline-alkali condition of this soil restricts the growth of some native plants.

This soil is poorly suited to trees and shrubs in windbreaks. Species should be selected that can tolerate a moderately saline or alkaline condition. The survival rate of seedlings is higher if competing vegetation is controlled or removed by good site preparation. Undesirable weeds and grasses can be controlled by maintaining strips of sod between the tree rows and in the tree rows. The areas close to the trees can be hoed by hand or roto-tilled. Supplemental water can be provided by a drip system of irrigation during periods of low rainfall.

This soil is not suited to septic tank absorption fields because of flooding and wetness. Sewage lagoons need to be diked for protection from flooding and constructed on fill material that raises the bottom of the lagoon to a sufficient height above the seasonal high water table. This soil is not suitable for use as building sites because of flooding and wetness. Alternate sites on other soils that are suitable should be considered for these uses. Constructing roads and streets on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads and streets from floods and wetness.

This soil is assigned to capability units IVs-1 dryland and IIIs-6 irrigated. It is in the Saline Subirrigated range site and in windbreak suitability group 9S.

Yx—Yockey very fine sandy loam, channeled. This soil is deep, very gently sloping, and somewhat poorly drained. Slopes typically range from 0 to 2 percent. The soil formed in stratified loamy, calcareous alluvium on bottom lands that are dissected by deeply cut stream channels. It is subject to occasional flooding. The stream channels and the adjacent streambanks are included in the areas of this map unit. The areas, which range from 5 to 125 acres in size, are long and narrow.

Typically, the surface layer is light brownish gray, very friable, calcareous very fine sandy loam about 4 inches thick. A transitional layer is light brownish gray, very friable, calcareous loamy very fine sand about 6 inches thick. The underlying material is stratified and calcareous. It is very pale brown very fine sandy loam in the upper part and pale brown very fine sandy loam in the middle part. In the lower part, between a depth of 42 inches and a depth of 60 inches or more, it is pale brown gravelly loamy very fine sand. In some places the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Craft soils. The Craft soils are well drained and are in slightly higher positions on the landscape. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate. Runoff is slow. The available water capacity is high. The seasonal high water table is at a depth of about 2 to 4 feet. The content of organic matter is low.

Most of the acreage of this soil is in native grasses and is used as rangeland. In some places, native trees are growing up.

This soil is not suited to use as farmland because of flooding and because the entrenched, meandering stream channels make many areas inaccessible.

This soil is suited to use as rangeland. This use effectively controls soil blowing and water erosion. Overgrazing by livestock and silt deposits on the soil reduce the protective cover and cause the native plants to deteriorate. Proper grazing use, timely deferment of grazing, and a planned grazing system help maintain or improve the range condition.

This soil generally is not suited to trees and shrubs in windbreaks because of the irregularly channeled areas that are subject to flooding.

This soil is suited to wild herbaceous plants that provide food and cover for woodland and rangeland wildlife.

This soil is not suited to sanitary facilities or to use as building sites because of flooding and wetness. A suitable alternate site should be considered for these uses. Constructing roads on suitable, well-compacted fill material above flood level and providing adequate side ditches and culverts help prevent damage to roads from floods and wetness.

This soil is assigned to capability unit VIw-3 dryland. It is in the Silty Overflow range site and in windbreak suitability group 10.

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. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 6 percent.

Soils that have a high water table, are subject to flooding, or are droughty may qualify as prime farmland soils if the limitations or hazards are overcome by drainage, flood control, or irrigation. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

About 168,240 acres in Morrill County, or nearly 19 percent of the county, is prime farmland.

A recent trend in land use in some parts of the county has been the conversion of some prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, or difficult to cultivate and less productive than prime farmland.

The map units, or soils, that make up prime farmland in Morrill County are listed in table 7. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." The list does not constitute a recommendation for a particular land use.

Use and Management of the Soils

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

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

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

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

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

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

Crops and Pasture

William E. Reinsch, conservation agronomist, Soil Conservation Service, helped prepare this section.

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

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

According to the Nebraska Agriculture Census, about 25 percent of the land in farms in Morrill County is used as cropland. Most of the acreage is in dryland winter wheat-summer fallow and in irrigated corn. The rest is in irrigated alfalfa, dry edible beans, and sugar beets. About 51 percent of the cropland is irrigated.

The potential of the soils in Morrill County for increased production of food is good.

Dryland Management

Good management practices for dry-farmed cropland are those that reduce runoff, reduce the risk of erosion, conserve moisture, and improve tilth. Most of the soils in Morrill County are suitable for crop production if the right crops are planted and if the fields are carefully managed. In many places, however, erosion is a severe hazard.

Terraces, contour farming, and a conservation tillage system that keeps crop residue on the surface help reduce water erosion. Crop residue on the surface or a protective plant cover reduces sealing and crusting of the soil during and after heavy rains. Crop residue also provides a stable bank of plant nutrients that cannot be lost by leaching or volatilization. In winter, tall stubble on a field catches drifting snow which provides additional moisture.

Soil blowing is a hazard in Morrill County, especially during periods of below average rainfall. Crop residue on this soil, conservation tillage, and stripcropping help control soil blowing.

Erosion in general can be reduced if the productive level or nearly level soils are used for row crops and the steeper, more erodible soils are used for wheat, alfalfa, or other close-growing crops or for hay and pasture. Proper use of the soils can reduce the hazard of erosion in many places.

In Morrill County, where rainfall is limited and wind and water erosion are hazards, a conservation cropping system is essential in dryland crop production.

For dry-farmed soils, the cropping system should include practices that help preserve tilth and fertility, maintain a plant cover that protects the soils from erosion, and control weeds, insects, and diseases.

Cropping systems vary according to the soils on which they are used. For example, the cropping system for Alice fine sandy loam, 6 to 9 percent slopes, eroded, should include conservation tillage that leaves 1,500 pounds per acre of small-grains residue on the surface to protect the soil from water and wind erosion. On Keith loam, 0 to 1 percent slopes, however, 1,000 pounds of small-grains residue is sufficient to protect the soil from erosion.

In dryland farming, the cultivation process should be cut down to essentials. Soils need to be worked to prepare a seedbed, to control weeds, and to provide a favorable place for plants to grow. Excessive tillage, however, breaks down the granular structure in the surface layer that is needed for good tilth. Eco-fallow, till-plant, disc-plant or chisel-plant, and stubble mulch are conservation tillage systems that are well suited to all crops commonly grown in Morrill County. Grasses can be established by drilling the seed into a cover of stubble without further seedbed preparation.

Soil tests can determine the need for additional nutrients on all soils that are used for cultivated crops or for pasture. Under dryland management, the kind and amount of fertilizer that is used should be based on the results of soil tests, the kind of crop grown, and the content of moisture in the soil at the time that the fertilizer is applied. If the subsoil is dry and rainfall is low, the amount of fertilizer applied should be slightly less than that needed when the soil is moist. Nitrogen fertilizer benefits all crops except legumes on all the soils. Phosphorous and zinc are needed on the more eroded soils and in cut areas after the construction of terraces or diversions. Dry-farmed soils need less fertilizer than irrigated soils because the plant population is lower.

The best management practices to reduce erosion on the soils that are in capability classes IIc, IIw, and IIe include leaving crop residue on the surface and adding nutrients by applying fertilizers or feedlot manure. On soils that are in class IIIe and IVe, the best management practices include leaving the crop residue on the soil over winter, stripcropping, using a conservation tillage system that leaves 3,000 pounds per acre of corn residue or 1,500 pounds of small-grains residue on the surface after the following crop is planted. On long, uniform slopes, the best management practices are leaving crop residue on the soil over winter, farming on the contour, terracing, and using a conservation tillage system that leave 3,000 pounds per acre of corn or sorghum residue or 1,500 pounds per acre of small-grains residue on the surface after the next crop is planted. Converting cropland to pasture or hayland and maintaining a permanent cover on the soil may be an economical alternative on class IV soils.

Some soils in Morrill County, for example, the Otero Variant and Platte and Els soils, have a seasonal high water table. Crops that can tolerate wet conditions should be planted on these soils if the water level cannot be lowered.

Gering soils, the Yockey alkali soil, Janise soils, and Wildhorse soils have chemical properties that are not favorable to many climatically adapted plants. Saline or sodic conditions affect the kind and production of crops and forage plants. Drainage can improve these soils. Surface ditches or subsurface tile can be used, depending on available outlets. Crops and forage plants having a degree of salt tolerance can be grown on these soils. Barley, sugar beets, and wheat are more tolerant than field beans, corn, and potatoes; forage species of tall wheatgrass and birdsfoot trefoil are more tolerant than alfalfa and orchardgrass.

Herbicides are highly effective in controlling weeds; however, it is important to apply the correct herbicide at a rate that corresponds to soil conditions. Colloidal clay and humus in the soil are responsible for most of the chemical activity in the soil. Consequently, herbicides can damage crops on sandy soils, which are low in collodial clay, and on soils that have a moderately low or low content of organic matter. On these soils, herbicides should be applied at correspondingly lower rates according to manufacturers' instructions. Choosing herbicides with a particular soil in mind lessens the danger of damage to the crops.

Irrigation Management

About 51 percent of all cropland in Morrill County is irrigated. Corn, alfalfa hay, dry edible beans, and sugar beets are grown on 70 percent of the irrigated cropland. Wheat, potatoes, and other crops are also grown. Canals and wells supply the irrigation water.

Either a gravity (furrow) or a sprinkler system is suited to row crops. Border, contour ditch, corrugation, or sprinkler systems are suitable for alfalfa.

The cropping system for soils that are well suited to irrigation consists mainly of row crops. A change from row crops to small grains and alfalfa, or grass helps control the plant diseases and insects that are common if the same crop is grown year after year.

Gently sloping soils, Keith loam, 3 to 6 percent slopes, for example, are subject to erosion by water if they are irrigated down the slope. These soils can be bench leveled on the contour for a gravity system of irrigation, or contour furrows can be used in combination with parallel terraces.

Contour bench leveling is used where excessive slope makes irrigation difficult or hazardous. The field is divided into a series of strips on the approximate contour, and each strip is leveled as an independent area. Thus, a series of strips is formed down the slope, and the grade of the soil is reduced. Contour bench leveling has advantages. The flat benches permit efficient use of irrigation water and rainfall. The ratio of water intake to water applied is good. Also, erosion from rainfall can be controlled in the leveled areas. Consequently, there is no interference with the soil-building processes that result in increased fertility and improved soil structure.

Land leveling increases the efficiency of irrigation because water is more evenly distributed on a level surface. The efficiency of a gravity system of irrigation can be improved if a tailwater recovery system is added.

A tailwater recovery pit can be installed at the lower end of a gravity irrigated field to collect excess irrigation water. This water can then be pumped to the upper end of the field and used again. This practice helps conserve the supply of ground water.

Concrete-lined irrigation laterals can conserve water where there is a need to convey irrigation water from a canal or from a pump to a field. Concrete-lined ditches can prevent erosion down slope and can conserve water on porous soils.

Sprinkler irrigation is most satisfactory on coarse textured soils. Sprinklers can be used on the more sloping soils as well as on nearly level soils. Some soils, Keith loam, 6 to 9 percent slopes, eroded, for example, or Mitchell very fine sandy loam, 6 to 9 percent slopes, are suited to sprinkler irrigation if conservation practices to control erosion are used. Terraces, contour farming, contour bench leveling, grassed waterways, and a conservation tillage system that keeps crop residue on the surface after the next crop is planted help protect the soils from erosion and help conserve the supply of surface water.

In sprinkler irrigation, water is applied at a rate that allows the soil to absorb the water, and there is no runoff. Because the water can be controlled, sprinklers have special use in conservation. They can be used, for example, in establishing pasture on strongly sloping soils.

There are two general kinds of sprinkler systems. One kind is set up at a certain location and left there until a specified amount of water is applied (fig. 15). The other kind is a single lateral, mounted on wheels, that rotates around a center point or moves in a straight line.

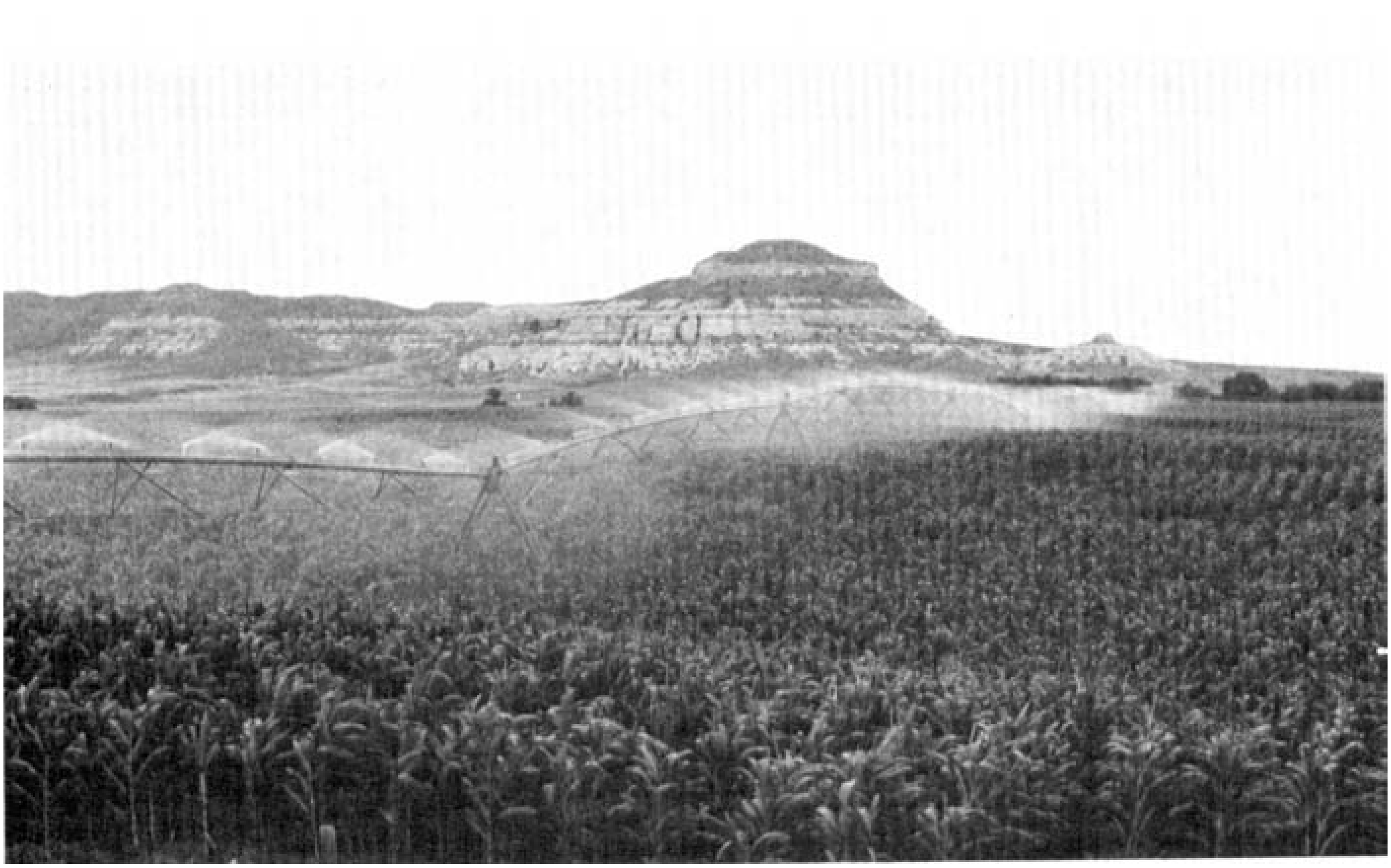


Figure 15.—A sprinkler system is used to irrigate corn on Sarben soils. Roundhouse Rock is in the background.

Because soils hold a limited amount of water, irrigation water is applied at regular intervals to keep the soil constantly moist. The intervals vary according to the soil, the crop, and the time of year. The water should be applied no faster than the soil can absorb it. Under sprinkler irrigation, crop residue on the soil can increase the water-intake rate and can slow the evaporation rate.

Irrigated silt loam soils in Morrill County hold about 2 inches of available water per foot of soil depth. A soil that is 4 feet deep and is planted to a crop that sends its roots to a depth of 4 feet can hold about 8 inches of available water for that crop.

For maximum efficiency, irrigation should be started when about one-half of the stored water has been used by the plants. If a soil holds 8 inches of available water, irrigation should be started when about 4 inches has been used by the plants. An irrigation system should be planned to replace the amount of water that is used by the plants.

All of the soils in Nebraska are placed in irrigation design groups, which are described in the Nebraska Irrigation Guide *(13)*. Arabic numbers designate the irrigation design group to which a soil belongs.

Management of Pasture and Hayland

Once a pasture is established, the grasses should be kept productive. Rotation grazing that meets the needs of the plants and promotes uniform use of forage is needed for high returns. Many forages are a good source of minerals, vitamins, proteins, and other nutrients. A well managed pasture thus can provide a balanced ration throughout the growing season. Irrigated pasture requires a higher level of management for maximum returns than dryland pasture.

If well managed, a mixture of grasses and legumes can be grown on many different kinds of soils and return a fair profit. Grasses and legumes are compatible with grain crops in a crop rotation and have beneficial soil building effects. Grasses and legumes improve tilth, add organic matter, and reduce erosion hazard. Thus, they are ideal for use in a conservation cropping system.

The most common grasses on irrigated pasture in Morrill County are smooth brome and orchardgrass. Other adapted grasses and legumes are intermediate wheatgrass, meadow brome, and creeping foxtail. Legumes that have a potential for pasture are alfalfa, birdsfoot trefoil, and cicer milkvetch. Under high level management, irrigated pastures in Morrill County can produce 750 to 900 pounds of beef per acre. Irrigated pastures are a good alternative in selecting a management system for irrigated cropland.

Grasses that have potential for production of dryland pasture are the wheatgrasses; namely, crested, intermediate, pubescent, and western wheatgrass. Smooth brome is well suited to the lower, wetter sites.

Grasses and legumes that are used for pasture and hay, irrigated or dryland, need additional plant nutrients for maximum production. The kinds and amounts of fertilizer needed should be determined by soil tests.

Yields Per Acre

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

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

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

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

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

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

Land Capability Classification

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

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. 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 limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. In Morrill County, class V contains only the subclass indicated by *w* 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, IIw-4 or IIIe-3.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Peter N. Jensen, range conservationist, Soil Conservation Service, helped prepare this section.

Rangeland makes up approximately 75 percent of the total agricultural land in Morrill County. It is scattered throughout the county, but the greatest concentration is in the sandhills in the northeastern part of the county and in the upland breaks. There is rangeland north and south of the Platte River, including part of the Wildcat Hills. Soils that are strongly affected by alkali along the Platte River are used primarily for native hay production. Rangeland is common in the Valentine, Valent, Tassel-Busher-Rock outcrop, and Janise-Lisco-Gering soil associations.

Most of the rangeland in the county is in the Sands, Sandy, Shallow Limy, Silty, and Limy Upland range sites (fig. 16). The rest is in the Wet Land, Wet Subirrigated, Subirrigated, Saline Subirrigated, Silty Overflow, Saline Lowland, Silty Lowland, Sandy Lowland, Choppy Sands, and Shallow to Gravel range sites. Ranches or livestock farms in Morrill County, on the average, are about 2,000 acres in size. Some ranches, however, are as large as 50,000 acres.

The raising of livestock, mainly cow and calf herds, is the largest agricultural industry in the county. Cattle graze the range in the large ranching areas generally from late in spring to early in fall. Calves are sold in the fall as feeders. The livestock spend the rest of the year grazing native meadow regrowth or, in winter, pastures near the headquarters. They are fed native hay or alfalfa, or both, during winter and during periods of heavy snow cover. The livestock on farms along the Platte River graze range from late in spring to early in fall. They then graze corn stalks or beet tops until winter when they feed on native hay or alfalfa or silage, or both, for the rest of the winter. In addition, the native forage commonly is supplemented with protein.

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

Table 8 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 8 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants.

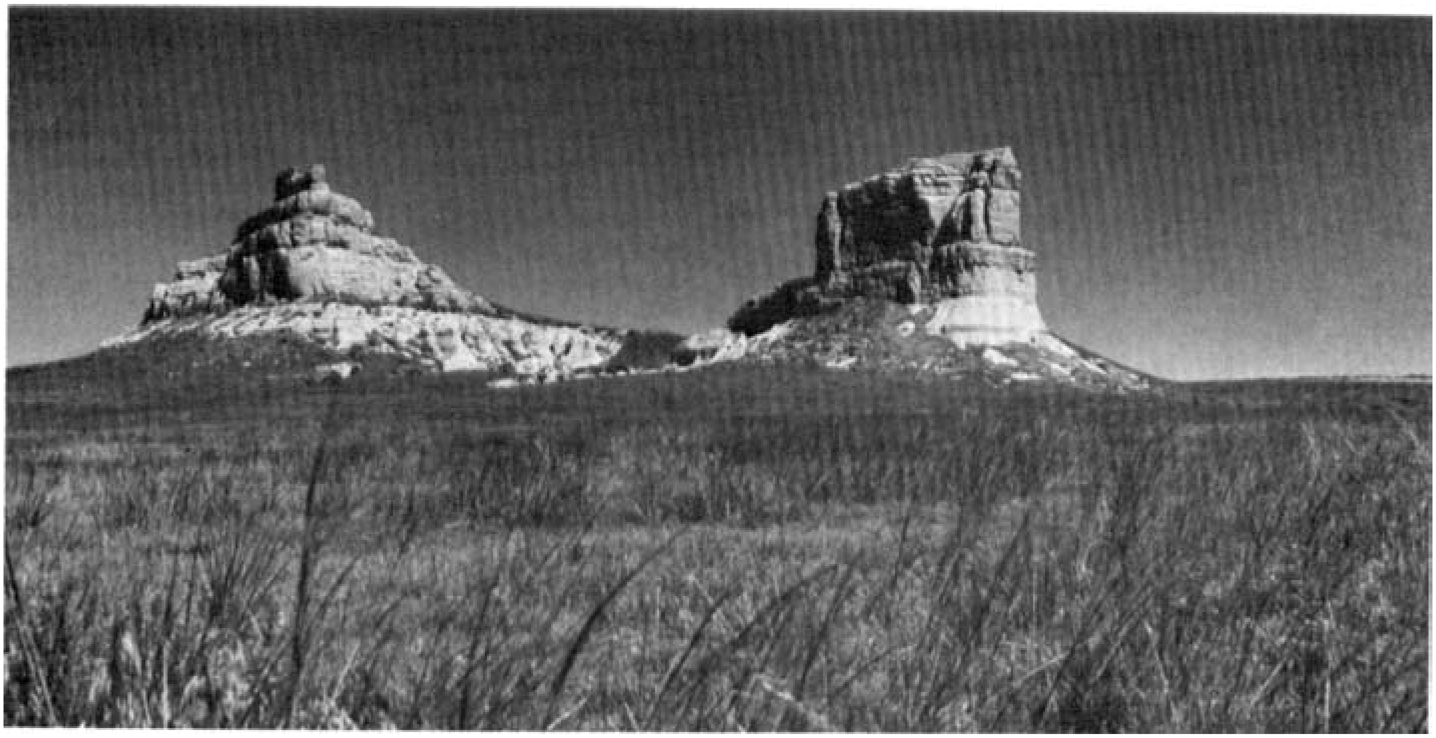


Figure 16.—A view of Limy Upland range site. Court House and Jail Rock, two prominent landmarks in Morrill County, are in the background.

The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

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

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

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

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

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

Approximately one-half of the rangeland has been depleted or is producing less than one-half of its potential, mainly because of overstocking and poor livestock distribution. The productivity of the range can be increased by proper range management; namely, proper grazing, deferred grazing, a planned grazing system, range seeding, and brush control.

Native Hayland (Meadow)

Some of the rangeland in Morrill County is used for the production of native hay. Meadows generally are common where the water table is high. Many of these areas are moderately to strongly affected by alkali. A limited amount of hay is harvested in the sandy uplands.

The meadows are associated with the Wet Land, Wet Subirrigated, Subirrigated, Saline Subirrigated, and Sandy range sites. The dominant vegetation in meadows is big bluestem, sand bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, prairie sandreed, alkali sacaton, and various members of the sedge family. Mowing has reduced the population of native wildflowers.

Production on the native meadows and on the sandy uplands can be maintained or improved by proper haying management. To maintain strong plant vigor and quality and quantity of hay production, mowing should be done before the grass seedheads emerge. Mowing height is important in maintaining the stand of grass and high forage production. Meadows should be mowed no closer than 3.5 inches. The sandy uplands should be mowed not more than once every 2 years.

Meadows should not be grazed when the soil is wet or when the water table is within 6 inches of the surface. Grazing at such a time causes the formation of small bogs or mounds, which later make mowing difficult. Meadows can be grazed for the aftermath or regrowth after frost.

At the end of each map unit description (in the section Detailed Soil Map Units), the soil or soils making up that map unit are placed in an appropriate range site according to the kind or amount of vegetation that is grown on the soil when the site is in excellent or climax condition. The interpretations for each range site in the county are available at the local office of the Soil Conservation Service. Ranchers or livestock producers who want technical help with ranch management or range improvement programs should visit the local office of the Soil Conservation Service.

Woodland Management and Productivity

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

In Morrill County, there are native trees on uplands and on the bottom lands of stream valleys. Most of the trees are in the southern part of the county.

Ponderosa pine is the most common species throughout the breaks to the valley south of the Platte River and in the eastern part of the Wildcat Hills. On the north- and east-facing slopes, the ponderosa pine is mainly in pure stands. The trees there are larger and are in more dense stands than those on the south- and west-facing slopes. Rocky Mountain juniper grows with the ponderosa pine on the south- and west-facing slopes. Skunkbush sumac grows on all aspects of the breaks.

Eastern cottonwood, black willow, Rusian-olive, and silver buffaloberry grow along the streams. The greatest concentration of trees and shrubs is along the Platte River.

In areas along the Platte River and in some areas on the north- and east-facing slopes of the breaks, the concentrations of trees are large enough to have commercial value.

Windbreaks and Environmental Plantings

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

Most of the ranch headquarters and farmsteads in Morrill County are sheltered by trees that have been planted at various times. In addition, many field windbreaks and shelterbelts have been planted throughout the county. Siberian elm is the most widely planted tree in windbreaks and shelterbelts. Other common trees and shrubs are eastern cottonwood, ponderosa pine, eastern redcedar, honeylocust, green ash, American elm, common hackberry, boxelder, American plum, lilac, and Siberian peashrub.

Many of the older windbreaks and shelterbelts are deteriorating because of crowding or because short-lived trees, Siberian elm for example, have reached or passed maturity. Such trees should be replaced to restore the effectiveness of the windbreak.

For windbreaks to fulfill their intended purpose, the trees and shrubs selected for planting need to be those that are adapted to the soils on the site. Accordingly, selecting the proper trees for a windbreak is the first step toward ensuring survival and maximum growth. The permeability, available water capacity, and fertility of a soil greatly affect the rate of growth of trees and shrubs.

Adequate moisture is an important factor in the survival of trees in Morrill County. Proper site preparation prior to planting and controlling weeds or other competing vegetation after planting are, therefore, the major concerns in establishing and managing a windbreak. Supplemental water, applied by drip irrigation or by some other suitable method, is commonly needed.

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

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife (fig. (17).

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

Robert O. Koerner, biologist, Soil Conservation Service, helped prepare this section.

In Morrill County, one state recreation area, at the west edge of Bridgeport, is maintained by the Nebraska Game and Parks Commission. The area takes in 127 acres of land and 70 acres of water; 3 acres are provided for picnicking and 5 acres for camping. The area has a boat ramp and a swimming beach.

Historic sites in the county include Chimney Rock National Historic Site, 3 miles southwest of Bayard; Courthouse Rock and Jail Rock, 5 miles south of Bridgeport; and Mud Springs Pony Express and Stage Station Site, 8 miles northwest of Dalton, Nebraska.

Figure 17.—Windbreaks along a field of dry edible beans. The soil is Alice fine sandy loam, 0 to 3 percent slopes.

There is a nine-hole golf course 5 miles south of Bridgeport. It is owned by the city and is open to the public.

Streams in the Upper Platte River Basin are well stocked with fish. The North Platte River is the major stream. Adult rainbow trout move westward from Lake McConaughy and spawn in the tributary streams of the North Platte: Red Willow Creek, Wildhorse Creek, and Stuckenhold Creek. Some private ponds, as well as public waters at the Bridgeport Recreation Area, are availale for fishing. The fish in this area include largemouth bass, smallmouth bass, bluegill, and crappie.

The field office of the Soil Conservation Service can provide technical assistance in designing facilities for recreation.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, 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 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

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.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Robert O. Koerner, biologist, Soil Conservation Service, helped prepare this section.

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

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

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

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

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

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are bur oak, green ash, willow, honeylocust, mulberry, Russian-olive, dogwood, and Siberian elm. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are American plum, common chokecherry, silver buffaloberry, honeysuckle, Siberian peashrub, and sumac.

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

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 skunkbush sumac, Arkansas rose, lilac, and sand sagebrush.

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

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

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

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

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

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

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include pronghorn antelope, deer, prairie dog, coyote, sharptail grouse, meadowlark, and lark bunting.

In the following paragraphs, the 14 soil associations in Morrill County are discussed in relation to wildlife.

The Duroc-Creighton-Oglala association, the Keith-Duroc-Creighton association, the Jayem-Valent-Busher association, the Valent-Sarben-Otero association, the Mitchell-Otero-Bridget association, and the Tripp-Alice-Duroc association provide habitat for a variety of openland wildlife species, including pheasant, cottontail rabbit, and mourning dove.

The topography in these areas is nearly level to moderately steep. The soils are mainly dry-farmed. Irrigation is used where water is available. The crops grown are grains, sugar beets, alfalfa, field beans, corn, and native and introduced grasses. A lack of adequate winter cover and of nesting cover in these areas critically limits the production of upland game birds. Farmstead and feedlot windbreaks and field windbreaks provide protection for deer and pheasants and for songbirds. The plant species are mainly green ash, Siberian elm, hackberry, redcedar, pine, common chokecherry, and caragana.

The Yockey-Glenberg-Bankard association provides habitat mainly for openland wildlife. The soils that make up this association are used mainly as irrigated cropland, which provides much suitable food for wildlife as well as good summer cover. White-tailed deer, mule deer, and pheasants are common here. Sugar beets, corn, dry edible beans, and alfalfa are the major crops.

Conservation tillage that keeps crop residue on the surface, plantings in critical areas, farmstead and feedlot windbreaks, and field windbreaks can provide food and cover for wildlife during the off-season.

The Tassel-Busher-Rock outcrop association, the Valentine association, the Dix association, and the Valent association provide good habitat for rangeland wildlife, such as pronghorn antelope, white-tailed deer, mule deer, sharptail grouse, meadowlarks, lark buntings, prairie dogs, coyotes, cottontails, and jackrabbits.

Native rangeland provides the main source of cover. Other sources of cover include cropland and farmstead windbreaks of redcedar, ponderosa, Scotch and Austrian pine, hackberry, honeylocust, green ash, Siberian elm, common chokecherry, and native plum.

The Wildcat Hills are good deer country. They also provide habitat for bobcat, porcupine, and wild turkey. Proper grazing use makes an important contribution to the establishment of good habitat for the wildlife in these areas.

The Valentine-Els-Wildhorse association and the Janise-Lisco-Gering association also provide habitat for rangeland wildlife. In these associations, there are many areas of wetland, which have the important element of water. The wetland areas attract waterfowl, shore birds, mink, muskrat, raccoon, and weasel. In many places, the wet areas are alkaline, and grasses, such as tall wheatgrass, alkali sacaton, and saltgrass are favored. Grasses, such as switchgrass, prairie cordgrass, and reed canarygrass, cattails, and bulrushes, grow in the meadows.

The Gothenburg-Barney-Platte association includes the stream corridor along the Platte River and the adjacent bottom lands where cultivated crops and hay are produced. Water, food, and cover are available for the varieties of wildlife that are present; moreover, the adjacent areas of cropland provide crop aftermath and provide additional food for wildlife. The areas of this association probably are visited at one time or another during the year by all the wildlife species in Morrill County. The most notable species are white-tailed deer, mule deer, wild turkey, coyote, cottontail, squirrel, mink, weasel, muskrat, raccoon, songbirds, hawks, owls, eagles, waterfowl, and shore birds.

Engineering

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

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

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

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

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

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

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

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

Building Site Development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

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

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

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 13 shows the degree and the 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 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

Construction Materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

Water Management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

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

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

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

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

Soil Properties

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

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

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

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

Engineering Index Properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

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

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

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

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

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19 and is computed by using the Nebraska modified system.

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

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

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

Physical and Chemical Properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

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

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

Flooding, the temporary inundation of an area, is caused by overflowing streams 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 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

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

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

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 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 18.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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

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

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

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

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

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

Physical and Chemical Analyses of Selected Soils

Samples from soil profiles were collected for physical and chemical analysis by the Soil Survey Laboratory, Soil Conservation Service, Lincoln, Nebraska. No series was sampled in Morrill County, but soils of the Altvan, Canyon, Keith, Keota, Mitchell, Tripp, and Valentine series were sampled in nearby counties. These data are recorded in Soil Survey Investigations Report Number 5 *(12)*.

This information is useful to soil scientists in classifying soils and developing concepts of soil genesis. It is also helpful in estimating available water capacity, susceptibility to soil blowing, fertility, tilth, and other aspects of soil management.

Engineering Index Test Data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by the Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and

Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and specific gravity, Method A—T 100-70 (ASSHTO). The group index number, which is part of the AASHTO classification, is computed by using the Nebraska Modified system.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(14)*. 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 20 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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 Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

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 Psammaquents (*Psamm*, meaning sandy, plus *aquent*, the suborder of the Entisols that have an aquic moisture regime).

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

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

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

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (11)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (14)*. 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."

Alice Series

The Alice series consists of deep, well drained soils on stream terraces of major stream valleys. Permeability is moderately rapid. The soils formed mainly in loamy alluvium and to a lesser extent in thin deposits of sandy and loamy eolian material. Slopes range from 0 to 15 percent.

Alice soils are similar to the Busher, Creighton, Jayem, Oglala, Tripp, and Vetal soils and are commonly near Bridget, Dix, Jayem, and Tripp soils. Busher soils have bedrock between 40 and 60 inches and are on uplands. Creighton soils have less fine sand or are coarser textured than Alice soils. Creighton soils are on uplands. Jayem soils are noncalcareous in the solum and are slightly higher on the landscape than Alice soils. Oglala, Tripp, and Bridget soils have less sand and more silt in the control section. Oglala soils have bedrock at a depth of 40 to 60 inches; they are on uplands. Bridget soils are calcareous at or near the surface; they are on foot slopes. Vetal soils have mollic epipedons more than 20 inches thick and are in swales. Dix soils are shallow over very gravelly loamy coarse sand; they are on uplands and breaks of stream terraces.

Typical pedon of Alice fine sandy loam, 0 to 3 percent slopes, 1,450 feet south and 2,150 feet west of the northeast corner of sec. 24, T. 21 N., R. 52 W.

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

A—8 to 15 inches; brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable; neutral; clear smooth boundary.

Bw1—15 to 22 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; dark brown (10YR 3/3, moist) faces on peds; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable; neutral; clear smooth boundary.

Bw2—22 to 29 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; neutral; abrupt smooth boundary.

Ck—29 to 35 inches; very pale brown (10YR 7/3 and 8/3) very fine sandy loam, brown (10YR 5/3) moist; many medium faint very pale brown (10YR 7/3, moist) streaks of segregated lime; massive with horizontal cleavage; slightly hard, friable; violent effervescence (16 percent calcium carbonate); moderately alkaline; clear smooth boundary.

C1—35 to 51 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; violent effervescence (10 percent calcium carbonate); moderately alkaline; clear smooth boundary.

C2—51 to 60 inches; very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) moist; massive; loose; slight effervescence; moderately alkaline.

The solum is 18 to 34 inches thick, and the depth to free carbonates is 18 to 34 inches. The mollic epipedon is 9 to 16 inches thick.

The A horizon has chroma of 2 or 3 dry or moist. It is typically fine sandy loam or loamy fine sand, but the range includes very fine sandy loam. The A horizon is neutral through moderately alkaline. The Bw horizon has value of 6 or 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically fine sandy loam, but the range includes very fine sandy loam and loamy very fine sand. The Bw horizon is neutral through moderately alkaline. The Ck horizon has value of 7 or 8 (5 or 6 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but the range includes fine sandy loam. The C horizon typically is very fine sandy loam and loamy fine sand, but the range includes fine sandy loam. The C horizon is mildly alkaline or moderately alkaline.

In some pedons, gravelly coarse sand is between a depth of 40 inches and a depth of 60 inches.

Map units AaB and AcD2 do not have a mollic epipedon, which is a characteristic of the Alice series. This difference, however, does not alter the use or behavior of the soils.

Altvan Series

The Altvan series consists of well drained soils that are moderately deep over very gravelly coarse sand. The soils formed in loamy sediment on uplands. Permeability is moderate in the solum and very rapid in the underlying material. Slopes range from 3 to 9 percent.

Altvan soils are commonly near Dix and Keith soils. Dix soils are shallow over very gravelly loamy coarse sand; they are on ridgetops and breaks. Keith soils are deep and have more silt and less sand in the control section. They and the Altvan soils are on about the same kind of landscape.

Typical pedon of Altvan loam, in an area of Altvan-Dix loams, 3 to 9 percent slopes, 1,150 feet west and 170 feet south of the northeast corner of sec. 14, T. 17 N., R. 52 W.

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

BA—10 to 13 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; common fine pebbles; neutral; clear smooth boundary.

Bt—13 to 20 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; dark brown (10YR 3/3) faces on peds; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; few fine pebbles; neutral; abrupt smooth boundary.

BCk—20 to 25 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; weak medium prismatic structure; slightly hard, very friable; few fine pebbles; violent effervescence; moderately alkaline; abrupt smooth boundary.

2Ck—25 to 33 inches; very pale brown (10YR 8/3) and pale brown (10YR 6/3) very gravelly coarse sand, pale brown (10YR 6/3) and brown (10YR 4/3) moist; single grained; loose; violent effervescence; moderately alkaline; clear smooth boundary.

2C—33 to 60 inches; very pale brown (10YR 7/3) very gravelly coarse sand, pale brown (10YR 6/3) moist; single grained; loose; moderately alkaline.

The solum is 16 to 30 inches thick, and the depth to free carbonates is 16 to 30 inches. The depth to very gravelly coarse sand ranges from 20 to 40 inches. The mollic epipedon is 8 to 20 inches thick.

The A horizon has value of 4 or 5 dry and chroma of 2 or 3 dry or moist. It is typically loam, but the range includes sandy loam. The Bt horizon has value of 4 or 5 moist and chroma of 2 or 3 dry or moist. It is typically sandy clay loam, but the range includes sandy loam. The 2C horizon typically is very gravelly coarse sand, but the range includes coarse sand.

Angora Series

The Angora series consists of deep, well drained, moderately permeable soils on ridgetops and side slopes of dissected uplands. The soils formed in calcaerous loess. Slopes range from 1 to 20 percent.

Angora soils are similar to Bridget, Creighton, and Mitchell soils and are commonly near Busher and Tassel soils. Bridget soils have a mollic epipedon and are on valley foot slopes and side slopes. Creighton soils have a mollic epipedon, and they have a thicker solum than that of Angora soils. Mitchell soils are calcareous throughout and do not have a B horizon. They are on valley foot slopes. Busher soils have a mollic epipedon. They have a thicker solum than that of Angora soils. They and Angora soils are in similar positions on the landscape. Tassel soils have sandstone bedrock at a depth of 10 to 20 inches. They are on side slopes at lower elevations.

Typical pedon of Angora very fine sandy loam, 1 to 6 percent slopes (fig. 18), 2,550 feet north and 850 feet east of the southwest corner of sec. 11, T. 22 N., R. 52 W.

A—0 to 5 inches; brown (10YR 5/3) very fine sandy loam, brown (10YR 4/3) moist; weak fine and very fine granular structure; soft, very friable; neutral; clear smooth boundary.

Bw1—5 to 8 inches; grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak very fine granular; soft, very friable; neutral; clear smooth boundary.

Bw2—8 to 11 inches; brown (10YR 5/3) very fine sandy loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak very fine granular; soft, very friable; neutral; clear smooth boundary.

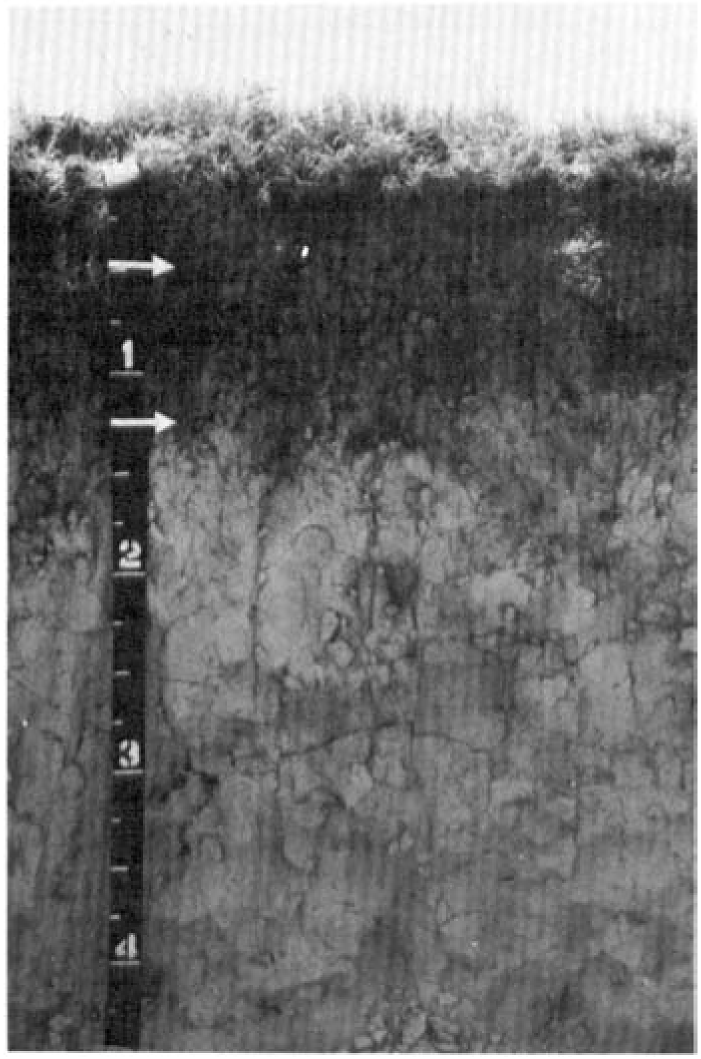


Figure 18.—A profile of Angora very fine sandy loam. This soil is deep and has a thin, brown surface layer. The upper and lower boundaries of the subsoil are indicated by the markers. The depth is in feet.

BC—11 to 16 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; weak coarse prismatic structure; soft, very friable; lacework pattern of calcium carbonate threads 1 millimeter wide; strong effervescence; mildly alkaline; clear smooth boundary.

Ck—16 to 24 inches; very pale brown (10YR 7/3) and light gray (2.5YR 7/2) very fine sandy loam, brown (10YR 5/3) and light brownish gray (2.5YR 6/2) moist; massive; slightly hard, friable; irregular pattern of calcium carbonate accumulations; violent

effervescence; moderately alkaline; gradual smooth boundary.
C—24 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; violent effervescence; moderately alkaline.

The solum is 11 to 20 inches thick. Free carbonates are at a depth of 5 to 20 inches.

The A horizon has value of 4 through 6 dry and 3 or 4 moist and chroma of 2 or 3 dry or moist. Reaction is neutral through moderately alkaline. The Bw horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 3 through 5 moist, and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but the range includes loam. It is neutral through moderately alkaline. The C horizon has hue of 10YR or 2.5Y, value of 6 through 8 dry and 5 or 6 moist, and chroma of 2 or 3 dry or moist. It is mildly or moderately alkaline.

Bankard Series

The Bankard series consists of deep, somewhat excessively drained, rapidly permeable soils on bottom lands and alluvial fans. The soils formed in stratified, sandy calcareous alluvium. Slopes range from 0 to 3 percent.

Bankard soils are commonly near Glenberg and Valent soils. Glenberg soils are loamy and in positions on the landscape similar to those of the Bankard soils. Valent soils are not stratified, are leached of carbonates to a depth of 40 inches or more, and contain less gravel than the Bankard soils. Valent soils are on hummocks.

Typical pedon of Bankard loamy fine sand, 0 to 2 percent slopes, 2,500 feet north and 1,800 feet east of the southwest corner of sec. 29, T. 19 N., R. 50 W.

Ap—0 to 8 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.
AC—8 to 13 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.
C1—13 to 50 inches; stratified light gray (10YR 7/2) and very pale brown (10YR 7/3) loamy sand, loamy fine sand, loamy very fine sand, and fine sand, grayish brown (10YR 5/2), brown (10YR 5/3), and pale brown (10YR 6/3) moist; single grained; loose; slight effervescence; moderately alkaline; abrupt smooth boundary.
C2—50 to 60 inches; light gray (10YR 7/2) sand, grayish brown (10YR 5/2) moist; single grained; loose; 13 percent gravel; slight effervescence; moderately alkaline.

The solum is 4 to 8 inches thick. Free carbonates are typically at the surface, but in some places the upper part of the solum is noncalcareous. Reaction is neutral through moderately alkaline.

The A horizon has value of 5 or 6 (3 through 5 moist) and chroma of 2 or 3 dry or moist. The A horizon is fine sand, loamy fine sand, or loamy coarse sand, although the range includes loamy sand. The C horizon has color value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3 dry or moist. In some pedons the C horizon has strata of very gravelly coarse sand and coarse sand.

Barney Series

The Barney series consists of poorly drained soils that are shallow over gravelly sand and gravelly coarse sand. The soils formed on bottom lands in thin loamy alluvial material over sand and gravel. Permeability is moderately rapid in the upper part and rapid in the lower part. Slopes range from 0 to 1 percent.

Barney soils are similar to Marlake and Platte soils and are commonly near Gothenburg, Platte, and Yockey soils. Marlake soils are wet for longer periods than the Barney soils. Marlake soils do not have gravelly sand and gravelly coarse sand within a depth of 30 inches. Platte soils are somewhat poorly drained, have a water table at a slightly lower depth, and are on higher bottom lands. Gothenburg soils have a lighter and thinner A horizon, are somewhat poorly drained, and are higher on the landscape. Yockey soils are somewhat poorly drained and have more silt and less sand in the control section. They are in higher positions on the landscape.

Typical pedon of Barney loam, 0 to 1 percent slopes, 1,800 feet east and 2,300 feet north of the southwest corner of sec. 24, T. 20 N., R. 51 W.

A—0 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.
C1—7 to 26 inches; white (10YR 8/1) gravelly sand, gray (10YR 6/1) moist, few medium distinct yellowish red (5YR 5/6, moist) mottles; single grained; loose; slight effervescence; mildly alkaline; gradual smooth boundary.
C2—26 to 60 inches; white (10YR 8/1) gravelly coarse sand, light gray (10YR 7/1) moist; single grained; loose; mildly alkaline.

The solum and the mollic epipedon range from 7 to 10 inches in thickness. The depth to gravelly sand ranges from 7 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2 dry or moist. It is typically loam, but the range includes sandy loam, fine sandy loam, very fine sandy loam, and silt loam. The A horizon is mildly alkaline or moderately alkaline. The C1 horizon has chroma of 1 or 2 dry or moist. The C1 horizon is typically gravelly sand, but the range includes loam and loamy sand. In some pedons there is no C1 horizon. The C2 horizon has hue of 10YR or 2.5Y. It is typically gravelly sand or gravelly coarse sand, but includes stratified layers of fine sand, sand, and coarse sand. The C2 horizon is neutral or mildly alkaline.

Bridget Series

The Bridget series consists of deep, well drained, moderately permeable soils on valley foot slopes and side slopes. The soils formed in loamy calcareous colluvial-alluvial sediment. Slopes range from 0 to 20 percent.

Bridget soils are similar to Angora, Creighton, Mitchell, Oglala, and Tripp soils and are commonly near Duroc, Mitchell, and Tripp soils. Angora soils formed in loess and are on uplands. Creighton soils have more sand and less silt than Bridget soils. They are on uplands. Duroc soils are finer textured and are pachic. They are on concave alluvial fans and foot slopes slightly lower on the landscape than the Bridget soils. Mitchell soils do not have a mollic epipedon. Oglala soils have fine-grained, weakly cemented sandstone at a depth of 40 to 60 inches. Oglala soils are on uplands. Tripp soils have a B horizon and are on stream terraces.

Typical pedon of Bridget very fine sandy loam, 6 to 9 percent slopes, 450 feet east and 100 feet south of the northwest corner of sec. 20, T. 18 N., R. 46 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable; neutral; clear smooth boundary.

A2—4 to 11 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure; slightly hard, very friable; mildly alkaline; gradual smooth boundary.

AC—11 to 16 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; slightly hard, very friable; slight effervescence; moderately alkaline; gradual smooth boundary.

C1—16 to 25 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable; slight effervescence; moderately alkaline; clear smooth boundary.

C2—25 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The solum is 15 to 28 inches thick. Depth to free carbonates ranges from 0 to 15 inches. The mollic epipedon is 7 to 18 inches thick.

The A horizon has chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but the range includes loam. The A horizon is neutral or mildly alkaline. The C horizon has value of 6 through 8 (4 through 6 moist) and chroma of 2 or 3 dry or moist. The C horizon is very fine sandy loam and silt loam.

Busher Series

The Busher series consists of deep, well drained, and somewhat excessively drained soils on uplands. The soils formed in material that weathered from fine-grained sandstone bedrock. Permeability is moderately rapid. Slopes range from 1 to 30 percent.

Busher soils are similar to Alice, Creighton, Jayem, and Oglala soils and are commonly near Jayem, Tassel, and Vetal soils. Alice, Creighton, Jayem, and Vetal soils do not have fine-grained sandstone within a depth of 40 to 60 inches. Alice soils are on stream terraces. Jayem soils are free of carbonates to a depth of 40 inches. Oglala soils have more silt and less sand in the control section than Busher soils. Tassel soils are shallow to sandstone bedrock. Jayem, Oglala, and Tassel soils are in positions on the landscape similar to those of the Busher soils. Vetal soils have a mollic epipedon that is more than 20 inches thick. Vetal soils are in open swales and on alluvial fans and foot slopes.

Typical pedon of Busher loamy very fine sand, 1 to 6 percent slopes, 600 feet east and 150 feet south of the northwest corner, sec. 15, T. 23 N., R. 52 W.

A1—0 to 6 inches; brown (10YR 5/3) loamy very fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; abundant fibrous roots; few limy sandstone pebbles; neutral; clear smooth boundary.

A2—6 to 11 inches; brown (10YR 5/3) loamy very fine sand, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; abundant fibrous roots; few limy sandstone pebbles; neutral; clear smooth boundary.

Bw—11 to 19 inches; brown (10YR 5/3) loamy very fine sand, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; common fibrous roots; few limy sandstone pebbles; neutral; clear smooth boundary.

C1—19 to 26 inches; pale brown (10YR 6/3) loamy very fine sand, brown (10YR 4/3) moist; vertical cleavage planes; soft, very friable; common fibrous roots; common limy sandstone pebbles; mildly alkaline; clear smooth boundary.

C2—26 to 41 inches; very pale brown (10YR 7/3) loamy very fine sand, brown (10YR 5/3) moist; massive; soft, very friable; occasional fibrous roots; common limy sandstone pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

Cr—41 to 60 inches; very pale brown (10YR 7/3) weakly cemented limy sandstone, brown (10YR 5/3) moist; occasional fibrous roots in cracks; violent effervescence; moderately alkaline.

The solum is 16 to 34 inches thick. Free carbonates are at a depth of 24 to 36 inches. The mollic epipedon is 7 to 20 inches thick. Typically, weakly cemented limy sandstone extends from a depth of about 40 inches to a depth of 60 inches or more.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3 dry or moist. It is typically loamy very fine sand or very fine sandy loam, but the range includes loam and fine sandy loam. The A horizon is neutral or mildly alkaline. The Bw horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3 dry or moist. The Bw horizon is typically loamy very fine sand, but the range includes fine sandy loam, very fine sandy loam, and loam. The Bw horizon is neutral through moderately alkaline. The C horizon has value of 5 through 8 (4 through 7 moist) and chroma of 2 or 3 dry or moist. It is typically loamy very fine sand, but the range includes loamy fine sand, fine sandy loam, very fine sandy loam, and loam. The C horizon is mildly alkaline or moderately alkaline.

Canyon Series

The Canyon series consists of shallow, well drained soils on uplands. Permeability is moderate. The soils formed in loamy calcareous material that weathered from fine-grained sandstone bedrock. Slopes range from 3 to 9 percent.

Canyon soils are similar to Epping and Tassel soils and commonly are near Busher, Oglala, and Tassel soils. Epping soils have more silt in the control section than Canyon soils. The Epping soils formed in material that weathered from siltstone bedrock. Tassel soils have less clay in the control section. Busher soils are deep and have smoother, less steep slopes. The Oglala soils are also deep and have more silt and less sand than the Canyon soils. The Oglala soils are on side slopes lower on the landscape than the Canyon soils.

Typical pedon of Canyon very fine sandy loam, in an area of Oglala-Canyon very fine sandy loams, 3 to 9 percent slopes, 900 feet east and 150 feet north of the southwest corner of sec. 11, T. 23 N., R. 52 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and very fine granular structure; soft, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C—8 to 15 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; soft, very friabie; few small sandstone fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

Cr—15 to 26 inches; white (10YR 8/2) weakly cemented limy fine-grained sandstone bedrock; pale brown (10YR 6/3) and very pale brown (10YR 7/3) moist; violent effervescence.

The solum is 6 to 12 inches thick. Free carbonates are at a depth of 0 to 6 inches. The depth to the paralithic contact ranges from 6 to 20 inches. The solum is mildly alkaline or moderately alkaline.

The A horizon has value of 4 through 7 (3 through 6 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but the range includes loam. The C horizon has value of 6 through 8 (4 through 7 moist) and chroma of 2 or 3 dry or moist.

Craft Series

The Craft series consists of deep, well drained, moderately permeable soils on bottom lands. The soils formed in stratified calcareous alluvium. Slopes range from 0 to 2 percent.

Craft soils are similar to Glenberg and McCook and Mitchell soils and are commonly near McCook, Mitchell, Sarben, and Yockey soils. Glenberg and Sarben soils have more sand and less silt in the control section than Craft soils. McCook soils have a mollic epipedon. Yockey soils are somewhat poorly drained. McCook, Glenberg, and Yockey soils are in positions on the landscape similar to those of Craft soils. Sarben soils are on side slopes of valleys and on stream terraces.

Typical pedon of Craft very fine sandy loam, 0 to 1 percent slopes, 250 feet east and 150 feet south of the northwest corner, sec. 32, T. 19 N., R. 50 W.

Ap—0 to 6 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; slightly hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

A—6 to 14 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; slightly hard, friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—14 to 21 inches; light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—21 to 29 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; violent effervescence; mildly alkaline; clear smooth boundary.

C3—29 to 36 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist;

massive; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C4—36 to 40 inches; light gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) moist; massive; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C5—40 to 60 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The solum is 9 to 20 inches thick. Free carbonates are generally at the surface, but in some pedons they are leached to a depth of 10 inches.

The A horizon has value of 5 or 6 (3 through 5 moist). It is typically very fine sandy loam or loamy very fine sand, although the range includes loam. The A horizon is mildly alkaline or moderately alkaline to strongly alkaline. Some pedons have an AC horizon. The C horizon has value of 6 or 7 (4 or 5 moist) and chroma of 1 through 3 dry or moist. It is typically stratified very fine sandy loam, loam, silt loam, and silty clay loam. The C horizon is mildly alkaline or moderately alkaline, but the range includes very strongly alkaline.

Creighton Series

The Creighton series consists of deep, well drained, moderately permeable soils on uplands. The soils formed in calcareous loess and materials that weathered from fine-grained sandstone bedrock. Slopes range from 1 to 6 percent.

Creighton soils are similar to Alice, Angora, Bridget, Busher, Jayem, and Vetal soils and are commonly near Busher and Oglala soils. Alice soils have more fine or coarser sand in the control section than Creighton soils. Alice soils are on stream terraces. Angora soils have a thinner solum and do not have a mollic epipedon. Bridget soils contain less sand and more silt than Creighton soils and are on foot slopes. Busher and Oglala soils have weakly cemented fine-grained sandstone at a depth of 40 to 60 inches. Jayem soils are free of carbonates to a depth of 40 inches or more. Oglala soils have more silt and less sand than the Creighton soils. Vetal soils have a mollic epipedon more than 20 inches thick and are in swales.

Typical pedon of Creighton very fine sandy loam, 1 to 6 percent slopes (fig. 19), 300 feet east and 150 feet south of the northwest corner, sec. 2, T. 23 N., R. 52 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

A2—8 to 17 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

Bw—17 to 25 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

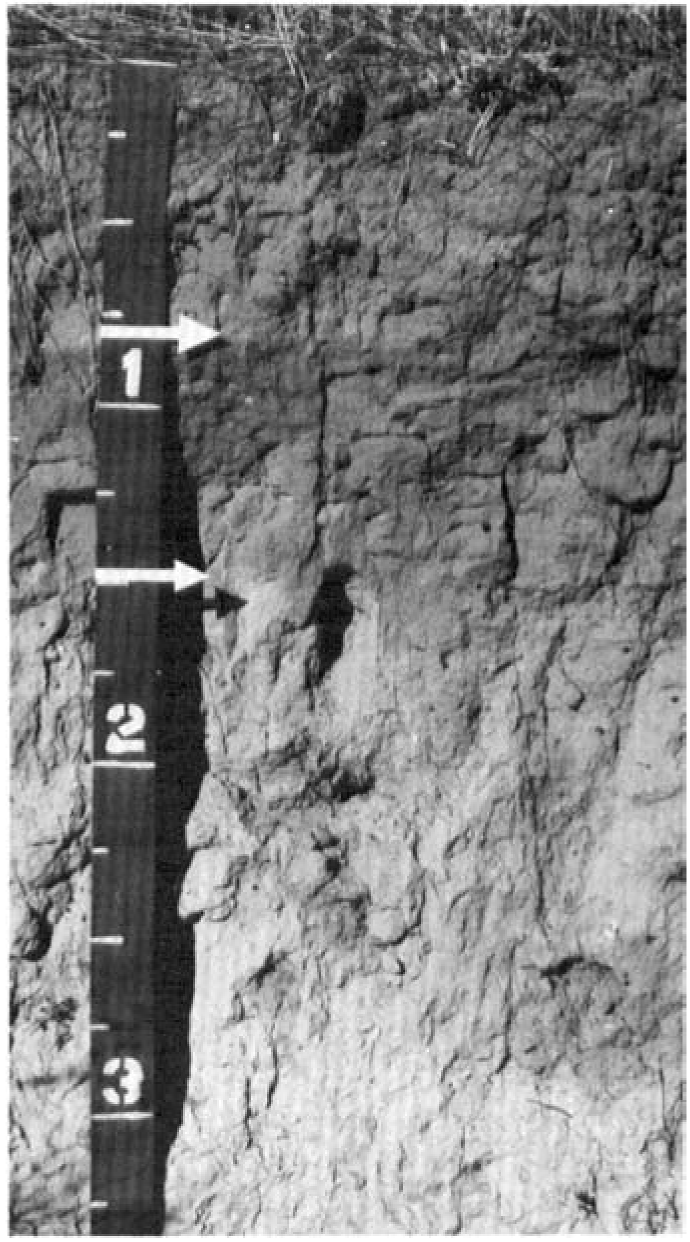


Figure 19.—A profile of Creighton very fine sandy loam. The upper and lower boundaries of the subsoil are indicated by the markers. The depth is in feet.

C1—25 to 36 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; slightly hard, friable; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—36 to 60 inches; light gray (10YR 7/2) loam, pale brown (10YR 6/3) moist; massive; soft, friable; violent effervescence; moderately alkaline.

The solum is 15 to 30 inches thick, and the depth to carbonates is 15 to 25 inches. The mollic epipedon is 7 to 19 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3 dry or moist. The A horizon is neutral or mildly alkaline. The Bw horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but the range includes loam. The Bw horizon is neutral or mildly alkaline. The C horizon has value of 6 through 8 (5 or 6 moist) and chroma of 2 or 3 dry or moist. It is typically loam, although in some places it is very fine sandy loam.

Dailey Series

The Dailey series consists of deep, somewhat excessively drained, rapidly permeable soils on uplands and stream terraces. The soils formed in thick, sandy eolian sediment. Slopes range from 0 to 9 percent.

Dailey soils are similar to Dunday soils and are commonly near Busher, Jayem, and Valent soils. The Dunday soils are not moderately alkaline. The Busher soils are well drained, are loamy, and typically have sandstone at a depth of 40 to 60 inches. They are on convex upland slopes. The Jayem soils are well drained and loamy. The Valent soils are excessively drained and do not have a mollic epipedon. The Jayem and Valent soils are in positions on the landscape similar to those of the Dailey soils.

Typical pedon of Dailey loamy fine sand, 3 to 9 percent slopes, 2,000 feet north and 2,000 feet east of the southwest corner, sec. 5, T. 20 N., R. 49 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable; abundant fibrous roots; neutral; gradual smooth boundary.

A2—6 to 18 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; weak medium prismatic structure; soft, very friable; common fibrous roots; mildly alkaline; gradual smooth boundary.

C1—18 to 28 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grained; soft, very friable; occasional fibrous roots; mildly alkaline; gradual smooth boundary.

C2—28 to 60 inches; light brownish gray (2.5Y 6/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose, very friable; moderately alkaline.

The solum and mollic epipedon are 10 to 20 inches thick. Free carbonates are at a depth of 40 inches or more.

The A horizon has chroma of 2 or 3 dry or moist. It is typically loamy fine sand, but the range includes fine sand and loamy sand. Some pedons have an AC horizon. The C horizon has hue of 2.5Y or 10YR. It is typically loamy sand and fine sand, but in some places it is loamy fine sand. The C horizon is neutral through moderately alkaline.

Dix Series

The Dix series consists of excessively drained soils that are shallow over coarse sand and gravel. Permeability is rapid over very rapid. The soils formed in loamy and sandy material over coarse sand to very gravelly loamy coarse sand on uplands, ridgetops, and breaks of stream terraces. Slopes range from 0 to 50 percent.

Dix soils are commonly near Alice, Altvan, and Tassel soils. Alice soils are deep and loamy. They are on stream terraces at higher elevations than Dix soils. Altvan soils have an argillic horizon, have very gravelly coarse sand at a depth of 20 to 40 inches. Altvan soils are at higher elevations than Dix soils. Tassel soils are shallow to sandstone bedrock and are on side slopes and crests of narrow upland ridgetops.

Typical pedon of Dix loamy sand, in an area of Alice-Dix complex, 3 to 6 percent slopes (fig. 20), 1,760 feet north and 640 feet east of the southwest corner, sec. 12, T. 20 N., R. 48 W.

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

AC—6 to 15 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable; neutral; clear smooth boundary.

2C1—15 to 45 inches; brown (10YR 5/3) very gravelly loamy coarse sand, dark grayish brown (10YR 4/2) moist; single grained; loose; neutral; gradual smooth boundary.

2C2—45 to 60 inches; light gray (10YR 7/2) coarse sand, grayish brown (10YR 5/2) moist; single grained; loose; neutral.

The solum and mollic epipedon are 7 to 15 inches thick. The pedon typically is leached, but in some pedons there are carbonates at a depth of only 8 inches. The solum is neutral through moderately alkaline.

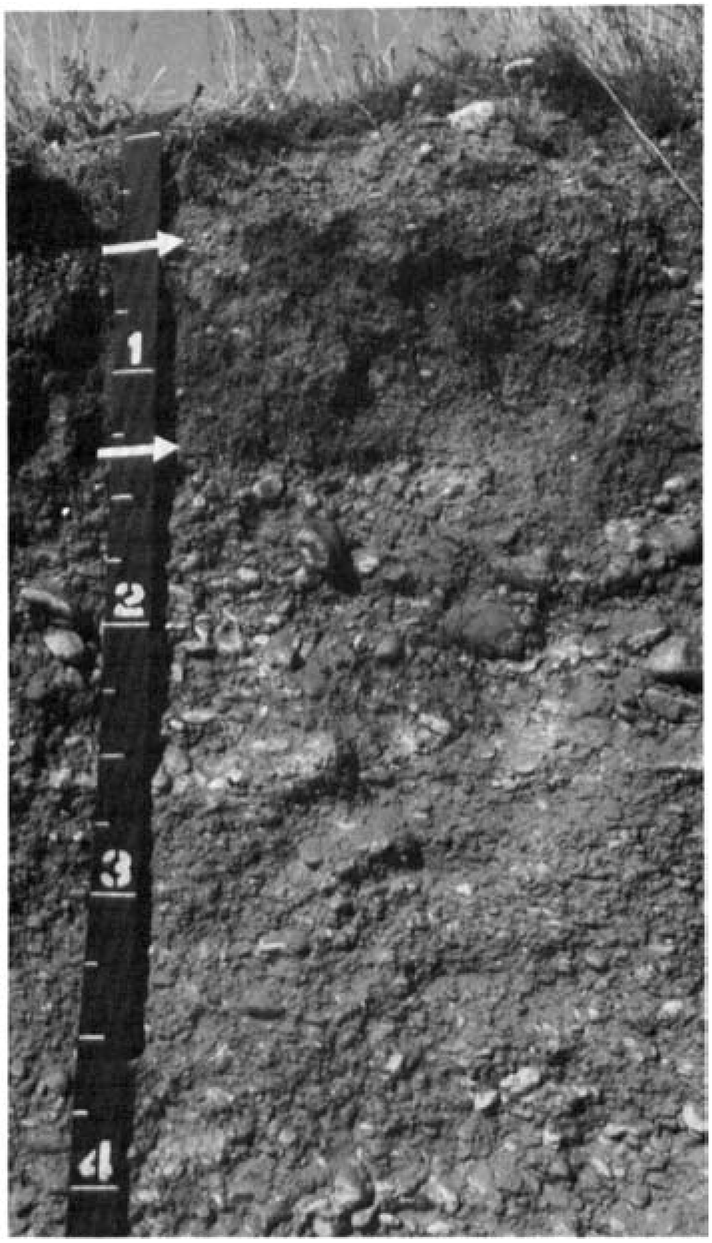


Figure 20.—A profile of Dix loamy sand. This soil is shallow over very gravelly, loamy coarse sand. It has a brown surface layer and a loamy sand transitional layer. The depth is in feet.

The A horizon has value of 4 or 5 dry and chroma of 2 or 3 dry or moist. The A horizon is typically loamy sand, loamy coarse sand, or sandy loam, although the range includes gravelly loamy sand and gravelly sandy loam. The 2C horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 through 4 dry or moist. It is typically very gravelly loamy coarse sand and coarse sand, but in some places it is very gravelly coarse sand, gravelly loamy coarse sand, and gravelly coarse sand. In the upper part of the 2C horizon the percent of gravel ranges from 35 to 50.

Map unit DsG has an A horizon that is lighter in color than the defined range for the Dix series. This difference, however, does not alter the use or behavior of the soil.

Dunday Series

The Dunday series consists of deep, somewhat excessively drained, rapidly permeable soils in enclosed sandhill valleys. The soils formed in eolian sand. Slopes range from 0 to 9 percent.

Dunday soils are similar to Dailey soils and are commonly near Els, Valentine, and Wildhorse soils. Dailey soils are moderately alkaline. The Els soils are somewhat poorly drained, do not have a mollic epipedon, and are in lower positions than those of the Dunday soils. The Valentine soils are excessively drained, do not have a mollic epipedon, and commonly are on dunes. The Wildhorse soils are somewhat poorly drained. They typically are strongly alkaline and very strongly alkaline. The Wildhorse soils are in lower positions on the landscape.

Typical pedon of Dunday loamy fine sand, 3 to 9 percent slopes, 100 feet north and 2,000 feet west of the southeast corner, sec. 25, T. 22 N., R. 47 W.

A1—0 to 9 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine granular; soft, very friable; neutral; gradual smooth boundary.

A2—9 to 18 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure; soft, very friable; neutral; gradual smooth boundary.

AC—18 to 28 inches; brown (10YR 5/3) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; soft, very friable; neutral; clear smooth boundary.

C—28 to 60 inches; pale brown (10YR 6/3) fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose; mildly alkaline.

The mollic epipedon is 10 to 20 inches thick. The solum is 14 to 28 inches thick. Free carbonates are at a depth of more than 40 inches.

The A horizon has value of 4 or 5 dry. The A horizon is slightly acid or neutral. The AC horizon has value of 5 or 6 and chroma of 2 or 3 dry or moist. The C horizon has value of 6 or 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically fine sand, but the range includes loamy fine sand. The C horizon is neutral or mildly alkaline.

Duroc Series

The Duroc series consists of deep, well drained, moderately permeable soils in open swales and on foot slopes on stream terraces and uplands. The soils formed in thick, calcareous alluvial-colluvial sediment and loess derived from fine-grained sedimentary rocks. Slopes range from 0 to 6 percent.

Duroc soils are similar to Keith and Vetal soils and are commonly near Bridget, Keith, and Tripp soils. Keith soils are coarser textured than Duroc soils and are not pachic. They are slightly higher in elevation; they are on valley foot slopes and side slopes. Vetal soils also are coarser textured. Bridget soils are not pachic, have an argillic horizon, and are higher on the landscape. Tripp soils are coarser textured, are not pachic, and are on stream terraces.

Typical pedon of Duroc loam, 0 to 1 percent slopes, 2,500 feet east and 190 feet north of the southwest corner, sec. 8, T. 18 N., R. 51 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; neutral; gradual smooth boundary.

A1—6 to 11 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure; slightly hard, friable; neutral; gradual smooth boundary.

A2—11 to 22 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

Bw—22 to 33 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

Ck—33 to 60 inches; light brownish gray (10YR 6/2) loam, brown (10YR 5/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The solum and mollic epipedon are 20 to 50 inches thick. Free carbonates are at a depth of 12 to 36 inches.

The A horizon has value of 4 or 5 and chroma of 2 or 3 dry or moist. The A horizon is neutral or mildly alkaline. The Bw horizon has value of 4 or 5 moist. Some pedons do not have a Bw horizon.

Els Series

The Els series consists of deep, somewhat poorly drained, rapidly permeable soils in enclosed valleys of the sandhills and on stream terraces. The soils formed in eolian sand and alluvial sand reworked by the wind. Slopes range from 0 to 2 percent.

Els soils are similar to Hoffland soils and are commonly near Hoffland, Valentine, and Wildhorse soils. The Hoffland soils are calcareous. They are poorly drained and very poorly drained. Typically, the A horizon of these soils is fine sandy loam. Hoffland soils are lower on the landscape than Els soils. The Valentine soils are excessively drained and do not have mottles within a depth of 40 inches. The soils are on dunes. Wildhorse soils typically are strongly alkaline and very strongly alkaline. They are in positions on the landscape similar to those of the Els soils.

Typical pedon of Els fine sand, 0 to 2 percent slopes, 2,400 feet west and 2,300 feet south of the northeast corner, sec. 36, T. 23 N., R. 48 W.

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

AC—6 to 14 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; few fine distinct yellowish red (5YR 5/8 moist) mottles; weak fine prismatic structure; loose; mildly alkaline; clear smooth boundary.

C1—14 to 23 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; common medium distinct brown (7.5YR 5/4 moist) mottles; single grained; loose; mildly alkaline; gradual smooth boundary.

C2—23 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose; mildly alkaline.

The solum is 6 to 19 inches thick. It is neutral through moderately alkaline. Typically, there are no free carbonates in the solum; however, there are exceptions.

The A horizon has value of 4 through 6 (2 through 5 moist) and chroma of 1 or 2 dry or moist. The A horizon is fine sand or loamy fine sand. The AC horizon has value of 5 or 6 dry (4 or 5 moist) and chroma of 1 or 2 dry or moist. It is typically fine sand, but the range includes loamy fine sand and loamy sand. The C horizon has value of 5 through 8 (4 through 6 moist). It is typically fine sand, but in some places it is loamy sand and sand. In some pedons, at a depth of 15 to 40 inches, there is a buried horizon of dark loamy fine sand or fine sand 2 to 8 inches thick.

Epping Series

The Epping series consists of shallow, well drained, and somewhat excessively drained soils on uplands and valley foot slopes. Permeability is moderate. The soils formed in materials that weathered from siltstone bedrock. Slopes range from 3 to 30 percent.

Epping soils are similar to Canyon and Tassel soils and are commonly near Keota and Mitchell soils. Canyon and Tassel soils formed in materials that weathered from sandstone bedrock. The soils have more sand and less silt in the control section than the Epping soils. Keota soils are moderately deep to siltstone bedrock and have more silt and less sand. Mitchell soils are deep and have more silt and less sand. The Mitchell soils are on foot slopes and on alluvial fans in lower positions on the landscape.

Typical pedon of Epping silt loam, in an area of Epping-Keota silt loams, 3 to 30 percent slopes, 530 feet east and 500 feet south of the northwest corner, sec. 29, T. 18 N., R. 52 W.

A—0 to 3 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

AC—3 to 10 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium prismatic structure; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C—10 to 15 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cr—15 to 25 inches; very pale brown (10YR 8/3) weakly cemented siltstone bedrock, pale brown (10YR 6/3) moist; strong effervescence; moderately alkaline.

The solum is 7 to 11 inches thick. The depth to carbonates is 0 to 6 inches, and the depth to paralithic contact is 10 to 20 inches.

The A horizon has value of 6 or 7 (3 or 4 moist) and chroma of 2 or 3 dry or moist. Texture is silt loam or very fine sandy loam. The A horizon is mildly alkaline or moderately alkaline. The AC horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically silt loam, although the range includes loam. Some pedons do not have an AC horizon. The C horizon has value of 6 or 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically silt loam, but in some places it is loam.

Gering Series

The Gering series consists of somewhat poorly drained soils that are moderately deep over coarse sand and gravel. The soils formed in loamy calcareous alluvium over sandy and gravelly alluvium on bottom lands. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slopes range from 0 to 1 percent.

These soils, as mapped in Morrill County, have a surface layer that is darker than is characteristic of the Gering series; however, this difference does not alter the use or behavior of these soils.

Gering soils are similar to Platte soils and are commonly near Glenberg, Janise, McCook, and Yockey soils. Platte soils have gravelly coarse sand within a depth of 20 inches. Glenberg soils are deep and are coarser textured than the Gering soils. The Janise soils are also deep and have less sand and more silt in the control section. The McCook soils are deep, coarser textured, and well drained. They are higher on the landscape than the Gering soils. The Yockey soils are deep, coarser textured, and silty. The Glenberg, Janise, and Yockey soils are in positions on the landscape similar to those of the Gering soils.

Typical pedon of Gering loam, alkali, 0 to 1 percent slopes, 1,700 feet west and 2,000 feet north of the southeast corner of sec. 33, T. 20 N., R. 50 W.

A1—0 to 9 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 3/2) moist; weak fine and very fine granular structure; slightly hard, very friable; strong effervescence; strongly alkaline; clear smooth boundary.

A2—9 to 16 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; moderate medium prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; violent effervescence; strongly alkaline; clear smooth boundary.

C—16 to 24 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; strong effervescence; very strongly alkaline; abrupt smooth boundary.

2C1—24 to 32 inches; very pale brown (10YR 7/3) coarse sand, brown (10YR 5/3) and pale brown (10YR 6/3) moist; few fine distinct yellowish red (5YR 5/6 moist) mottles; single grained; loose; moderately alkaline; gradual smooth boundary.

2C2—32 to 60 inches; very pale brown (10YR 7/3) gravelly coarse sand, brown (10YR 5/3) moist; common medium distinct yellowish red (5YR 5/8 moist) mottles; single grained; loose; moderately alkaline.

The solum is 8 to 16 inches thick. The depth to coarse sand and gravelly coarse sand is 20 to 40 inches.

The A horizon has value of 4 through 6 (3 through 5 moist) and chroma of 1 or 2 dry or moist. It is typically loam, but the range includes very fine sandy loam. The A horizon is moderately alkaline or strongly alkaline. The C horizon has value of 6 or 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically loam, although in some places it is very fine sandy loam and silt loam. The C horizon is moderately alkaline to very strongly alkaline. The 2C horizon is typically coarse sand and gravelly coarse sand, but the range includes very gravelly coarse sand.

Glenberg Series

The Glenberg series consists of deep, well drained soils on bottom lands. Permeability is moderately rapid. The soils formed in loamy and sandy stratified calcareous alluvium. Slopes range from 0 to 2 percent.

Glenberg soils are similar to Craft soils and are commonly near Bankard, Craft, Valent, and Yockey soils. The Craft soils are silty. The Bankard soils are sandy, excessively drained, and in positions similar to those of the Glenberg soils. The Valent soils are sandy also and typically are noncalcareous to a depth of 40 inches. The Valent soils are on hummocks and dunes higher on the landscape than the Glenberg soils. The Yockey soils are somewhat poorly drained, silty, and in lower positions.

Typical pedon of Glenberg very fine sandy loam, 0 to 2 percent slopes, 1,800 feet west and 1,200 feet north of the southeast corner, sec. 11, T. 18 N., R. 52 W.

Ap—0 to 8 inches; light brownish gray (10YR 6/2) very fine sandy loam, very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) moist; weak fine and very fine granular structure; soft, very friable; slight effervescence; moderately alkaline; clear smooth boundary.

C1—8 to 25 inches; stratified light brownish gray (10YR 6/2) very fine sandy loam and fine sandy loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) moist; massive; loose; strong effervescence; clear smooth boundary.

C2—25 to 60 inches; stratified light brownish gray (10YR 6/2) and light gray (10YR 7/2) fine sandy loam, loamy fine sand, loamy sand, and fine sand, dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), and light brownish gray (10YR 6/2) moist; massive; loose; strong effervescence; strongly alkaline.

The solum ranges from 4 to 8 inches. Free carbonates typically are at the surface, but are leached for a few inches in some pedons.

The A horizon has value of 3 or 4 moist and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam or loamy fine sand, but the range includes fine sandy loam and very fine sandy loam. The A horizon is mildly alkaline or moderately alkaline. The C horizon has color value of 5 through 8 (3 through 6 moist) and chroma of 1 through 3 dry or moist. Typically, it is stratified very fine sandy loam, fine sandy loam, loamy fine sand, loamy sand, and fine sand, but in some places it is loamy very fine sand or silt loam. The C horizon is moderately alkaline or strongly alkaline.

Gothenburg Series

The Gothenburg series consists of somewhat poorly drained soils that are shallow and very shallow over gravelly coarse sand. Permeability is very rapid. The soils formed on bottom lands in sandy alluvium over sandy and gravelly material. Slopes range from 0 to 2 percent.

Gothenburg soils are commonly near Barney and Platte soils. The Barney soils have a mollic epipedon, are poorly drained, and are lower on the landscape than the Gothenburg soils. Platte soils have a mollic epipedon and are higher on the landscape.

Typical pedon of Gothenburg loamy sand, 0 to 2 percent slopes, 800 feet west and 50 feet south of the northeast corner, sec. 30, T. 19 N., R. 48 W.

A—0 to 3 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, friable; strong effervescence; moderately alkaline; clear wavy boundary.

C1—3 to 14 inches; light gray (10YR 6/1 and 7/2) and light brownish gray (10YR 6/2) fine sand, light brownish gray (10YR 6/2), grayish brown (10YR 5/2), and dark gray (10YR 4/1) moist; few medium distinct brown (7.5YR 4/4, moist) mottles; single grained; loose; slight effervescence; moderately alkaline; abrupt smooth boundary.

C2—14 to 20 inches; light gray (10YR 7/2 and 6/1) coarse sand and loamy fine sand, light brownish gray (10YR 6/2) and dark gray (10YR 4/1) moist; single grained; loose; mildly alkaline; gradual smooth boundary.

C3—20 to 60 inches; light gray (10YR 6/1) gravelly coarse sand, gray (10YR 5/1) moist; single grained; loose; mildly alkaline.

The solum is 3 to 6 inches thick. The depth to gravelly coarse sand is 6 to 20 inches.

The A horizon has chroma of 2 or 3 dry or moist. It is typically loamy sand, but the range includes loam and loamy fine sand. The C horizon has value of 6 or 7 (4 through 6 moist) and chroma of 1 through 3 dry or moist. The C horizon is mildly alkaline or moderately alkaline. The C3 horizon has value of 6 or 7 (4 through 6 moist) and chroma of 1 through 3 dry or moist. It is typically gravelly coarse sand, but the range includes gravelly sand. The percent of gravel ranges from 15 to 30, although some pedons have thin strata of material that is 10 to 50 percent gravel. The C3 horizon is mildly alkaline or moderately alkaline.

Hoffland Series

The Hoffland series consists of deep, poorly drained and very poorly drained, rapidly permeable soils in sandhill valleys. The soils formed in sandy eolian material and alluvial sediment. Slopes range from 0 to 1 percent.

The Hoffland soils are similar to Els soils and are commonly near Els, Marlake, and Valentine soils. Els soils are somewhat poorly drained and in positions higher on the landscape than the Hoffland soils. Marlake soils have water on the surface most of the year. They are lower on the landscape. Valentine soils are excessively drained, do not have mottles within a depth of 40 inches, and are on dunes in higher positions on the landscape.

Typical pedon of Hoffland fine sandy loam, 0 to 1 percent slopes, 1,900 feet south and 1,000 feet west of the northeast corner, sec. 21, T. 21 N., R. 47 W.

O—2 inches to 0; partly decomposed grass litter; violent effervescence.

Ak—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

ACk—8 to 13 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; few fine distinct strong brown (7.5YR 5/6, moist) mottles; weak medium subangular blocky structure parting to weak fine granular; loose; violent effervescence; moderately alkaline; clear smooth boundary.

C—13 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; few fine distinct light olive brown (2.5Y 5/4, moist) mottles; single grained; loose; strong effervescence; moderately alkaline.

The solum is 7 to 20 inches thick. The mollic epipedon is 7 to 10 inches thick.

The Ak horizon has value of 3 through 6 (2 or 3 moist) and chroma of 1 or 2. It is typically fine sandy loam, but the range includes loam. The C horizon has value of 4 though 7 (2 through 6 moist) and chroma of 1 through 3. The C horizon is typically fine sand, but the range includes loamy fine sand and fine sandy loam.

Janise Series

The Janise series consists of deep, somewhat poorly drained soils on bottom lands. Permeability is moderately slow. The soils formed in mixed loamy calcareous alluvium. Slopes range from 0 to 1 percent.

Janise soils are similar to Lisco and Minatare soils and are commonly near Glenberg, Lisco, Minatare, and Yockey soils. Lisco and Glenberg soils are coarser textured than Janise soils. Minatare soils are finer textured than the Janize soils. Glenberg and Yockey soils are not strongly alkaline in the solum. Glenberg, Yockey, and Minatare soils are in positions on the landscape similar to those of the Janise soils.

Typical pedon of Janise loam, 0 to 1 percent slopes, 1,800 feet east and 1,400 feet south of the northwest corner, sec. 32, T. 20 N., R. 50 W.

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

E—2 to 4 inches; light gray (10YR 6/1) loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; soft, very friable; slight effervescence; strongly alkaline; abrupt smooth boundary.

Bw1—4 to 15 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium columnar structure; slightly hard, friable; violent effervescence; very strongly alkaline; gradual smooth boundary.

Bw2—15 to 19 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable; violent effervescence; very strongly alkaline; gradual smooth boundary.

BC—19 to 24 inches; light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; weak subangular blocky structure; slightly hard, friable; violent effervescence; very strongly alkaline; clear smooth boundary.

C1—24 to 30 inches; white (10YR 8/2) loam, light gray (10YR 7/2) moist; common distinct medium pale brown (10YR 6/3, moist) mottles; weak medium subangular blocky structure; hard, friable; violent effervescence; very strongly alkaline; abrupt smooth boundary.

C2—30 to 40 inches; pale brown (10YR 6/3) loamy fine sand; grayish brown (10YR 5/2) moist; soft, very friable; massive; slight effervescence; very strongly alkaline; abrupt smooth boundary.

2C3—40 to 60 inches; mixed very pale brown (10YR 7/4) and brown (10YR 5/3) coarse sand, light yellowish brown (10YR 6/4) moist; single grained; loose; slight effervescence; strongly alkaline.

The solum is 10 to 24 inches thick. The depth to carbonates is 0 to 6 inches.

The A horizon has value of 4 through 7 (3 or 4 moist) and chroma of 1 or 2 dry or moist. It is typically loam or silt loam, but the range includes very fine sandy loam. The A horizon is strongly alkaline or very strongly alkaline. In some areas there is no A horizon. The B horizon has value of 6 or 7 (4 or 5 moist). Typically, it is loam, but in some places it is silt loam. The C horizon has value of 6 through 8 (5 through 7 moist) and chroma of 2 or 3 dry or moist. It is strongly alkaline or very strongly alkaline. The 2C horizon is typically coarse sand, although the range includes gravelly sand. The 2C horizon is mildly alkaline to strongly alkaline. Some pedons do not have a 2C horizon.

Jayem Series

The Jayem series consists of deep, well drained soils commonly on uplands and in some places on stream terraces. Permeability is moderately rapid. The soils formed in loamy material that weathered from fine-grained sandstone bedrock and in eolian sediments. Slopes range from 0 to 20 percent.

Jayem soils are similar to Alice, Busher, Creighton, and Vetal soils and are commonly near Alice, Busher, Dailey, and Vetal soils. Alice and Creighton soils have free carbonates in the solum and have a continuous layer of accumulated lime. Alice soils are on stream terraces. Busher soils typically have free carbonates within a depth of 40 inches and have weakly cemented sandstone bedrock at a depth between 40 and 60 inches. Busher soils and the sandy Dailey soils are on uplands in positions on the landscape similar to those of the Jayem soils. Creighton soils are on uplands. Vetal soils are pachic and are in open upland swales and on alluvial fans in lower positions on the landscape.

Typical pedon of Jayem fine sandy loam, 0 to 3 percent slopes, 1,600 feet south and 50 feet west of the northeast corner, sec. 18, T. 18 N., R. 49 W.

A—0 to 11 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure; soft, very friable; neutral; clear smooth boundary.

Bw—11 to 20 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, firm; neutral; clear smooth boundary.

C1—20 to 49 inches; light brownish gray (10YR 6/2) fine sandy loam, dark brown (10YR 4/2) moist; massive; soft, very friable; neutral; gradual smooth boundary.

C2—49 to 60 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; slight effervescence; mildly alkaline.

The solum ranges from 15 to 40 inches in thickness, and the mollic epipedon ranges from 7 to 20 inches. Free carbonates are at a depth of more than 40 inches.

The A horizon has value to 4 or 5 (2 or 3 moist) and chroma of 2 or 3 dry or moist. It is fine sandy loam or loamy fine sand. Reaction is neutral or mildly alkaline. The B horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 through 4 dry or moist. It is typically fine sandy loam, but the range includes very fine sandy loam. The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4 dry or moist. It is typically fine sandy loam, but in some places it is loamy sand below a depth of 40 inches. It is neutral or mildly alkaline.

Keith Series

The Keith series consists of deep, well drained, moderately permeable soils on uplands. The soils formed in loess. Slopes range from 0 to 9 percent.

Keith soils are similar to Duroc soils and commonly are near them. Duroc soils are pachic and do not have an argillic horizon.

Typical pedon of Keith loam, 1 to 3 percent slopes, 1,200 feet east and 600 feet north of the southwest corner, sec. 17, T. 17 N., R. 51 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—6 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

Bt1—11 to 16 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; mildly alkaline; gradual smooth boundary.

Bt2—16 to 25 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

BC—25 to 30 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, very friable; slight effervescence; moderately alkaline; clear smooth boundary.

Ck—30 to 38 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C—38 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum is 16 to 38 inches thick. The depth to free carbonates is 15 to 33 inches. The mollic epipedon is 7 to 20 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2 dry or moist. It is typically loam and silt loam, but the range includes very fine sandy loam and fine sandy loam. The Bt2 horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically silt loam, but in some places it is loam, silty clay loam, or clay loam. The Bt2 horizon is neutral through moderately alkaline. Some pedons do not have a BC horizon. The C horizon has value of 6 through 8 (5 or 6 moist) and chroma of 2 or 3 dry or moist. It is typically silt loam, although the range includes loam and very fine sandy loam.

Map units KeC2 and KeD2 have a surface layer that is too thin to qualify as a mollic epipedon, which is a characteristic of the Keith series. This difference, however, does not alter the use or behavior of the soils.

Keota Series

The Keota series consists of moderately deep, well drained, moderately permeable soils on uplands and valley foot slopes. The soils formed in material that weathered from siltstone bedrock. Slopes range from 3 to 30 percent.

Keota soils are similar to Mitchell soils and are commonly near Epping and Mitchell soils. Mitchell soils are deep to siltstone bedrock, and Epping soils are shallow to siltstone bedrock.

Typical pedon of Keota silt loam, in an area of Epping-Keota silt loams, 3 to 30 percent slopes, 800 feet east and 500 feet south of the northwest corner, sec. 29, T. 18 N., R. 52 W.

A—0 to 5 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium granular structure; soft, very friable; mildly alkaline; clear smooth boundary.

AC—5 to 14 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak medium prismatic structure; soft, very friable; few siltstone pebbles; strong effervescence; moderately alkaline; gradual smooth boundary.

C—14 to 34 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive, weak medium subangular blocky structure; soft, very friable; few siltstone pebbles; violent effervescence; moderately alkaline; abrupt wavy boundary.

Cr—34 to 45 inches; very pale brown (10YR 8/3) weakly cemented siltstone bedrock, pale brown (10YR 6/3) moist; violent effervescence; moderately alkaline.

The solum is 7 to 14 inches thick. The depth to carbonates ranges from 0 to 10 inches, and the depth to paralithic contact ranges from 20 to 40 inches.

The A horizon has value of 6 or 7 (4 through 6 moist) and chroma of 2 or 3 dry or moist. It is typically silt loam, but the range includes loam. The A horizon is mildly alkaline or moderately alkaline. The AC horizon is typically loam, although the range includes silt loam. The C horizon is typically silt loam, but in some places it is loam.

Lisco Series

The Lisco series consists of deep, somewhat poorly drained soils on bottom lands. Permeability is moderately rapid. The soils formed in loamy calcareous alluvium that, in some places, has been reworked by wind. Slopes range from 0 to 2 percent.

Lisco soils are similar to Janise and Wildhorse soils and are commonly near Janise and Yockey alkali soils. Janise soils are silty, and Wildhorse soils are sandy. The Yockey alkali soils are silty and stratified. They are in positions on the landscape similar to those of the Lisco soils.

Typical pedon of Lisco very fine sandy loam, 0 to 2 percent slopes, 1,000 feet east and 900 feet north of the southwest corner, sec. 22, T. 19 N., R. 49 W.

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

E—2 to 4 inches; light brownish gray (10YR 6/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable; mildly alkaline; abrupt wavy boundary.

Bw1—4 to 7 inches; light brownish gray (10YR 6/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate coarse columnar structure; hard, friable; strong effervescence; very strongly alkaline; gradual smooth boundary.

Bw2—7 to 13 inches; light brownish gray (10YR 6/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure; hard, friable; moderately saline; strong effervescence; very strongly alkaline; gradual smooth boundary.

Bw3—13 to 22 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; slightly hard, very friable; strongly saline; violent effervescence; very strongly alkaline; gradual smooth boundary.

C1—22 to 48 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; moderately saline; strong effervescence; very strongly alkaline; gradual smooth boundary.

C2—48 to 60 inches; very pale brown (10YR 7/3) loamy fine sand, light brownish gray (10YR 6/2) moist; massive; soft, very friable; strong effervescence; strongly alkaline.

The solum ranges in thickness from 10 to 44 inches. Free carbonates are at a depth of 0 to 10 inches. The depth to loamy fine sand or to gravelly sand ranges from 40 to 60 inches or more.

The A and E horizons have value of 5 or 6 (3 or 4 moist) and chroma of 1 or 2 dry or moist. They are typically very fine sandy loam, but the range includes fine sandy loam, loamy fine sand, loam, and silt loam. The A and E horizons are slightly acid through moderately alkaline. The Bw horizon has value of 5 through 7 (3 through 5 moist) and chroma of 1 or 2 dry or moist. It is typically very fine sandy loam and fine sandy loam, but the range includes sandy loam. The Bw horizon is strongly alkaline or very strongly alkaline. The C horizon has value of 6 through 8 (4 through 7 moist) and chroma of 1 through 3 dry or moist. The C horizon is moderately alkaline through very strongly alkaline.

Marlake Series

The Marlake series consists of deep, very poorly drained, rapidly permeable soils commonly in depressions in sandhill valleys. In some places, the soils are in depressions bordering lakes and streams. The soils formed in eolian sand and in sandy and loamy alluvium. Slopes range from 0 to 1 percent.

Marlake soils are similar to Barney soils and are commonly near Els, Hoffland, and Wildhorse soils. The Barney soils are poorly drained and have gravelly sand or gravelly coarse sand at a depth between 10 and 20 inches. The Els soils are somewhat poorly drained and are higher on the landscape than the Marlake soils. Hoffland soils are not stratified within a depth of 40 inches and are slightly higher on the landscape. The Wildhorse soils are somewhat poorly drained and, typically, are strongly alkaline and very strongly alkaline. They also are higher on the landscape than the Marlake soils.

Typical pedon of Marlake fine sandy loam, 0 to 1 percent slopes, 300 feet west and 200 feet south of the northeast corner, sec. 27, T. 21 N., R. 47 W.

Oa—3 inches to 0; very dark gray (10YR 3/1) sapric soil materials, black (10YR 2/1) moist; soft, very friable; common snail shells; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—0 to 9 inches; gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; soft, very friable; abundant fibrous roots; common snail shells; strong effervescence; mildly alkaline; abrupt smooth boundary.

AC—9 to 16 inches; stratified light brownish gray (10YR 6/2) loamy fine sand and fine sand, very dark grayish brown (2.5Y 3/2), very dark gray (10YR 3/1), and dark grayish brown (10YR 4/2) moist; few fine faint dark reddish brown (5YR 3/4, moist) mottles; weak coarse subangular blocky structure; soft, very friable; occasional fibrous roots; few snail shells; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—16 to 26 inches; gray (5Y 6/1) stratified fine sand and loamy fine sand, dark gray (5Y 4/1) moist; single grained; loose; mildly alkaline; clear smooth boundary.

C2—26 to 60 inches; light brownish gray (2.5Y 6/2) fine sand, dark gray (5Y 4/1) moist; single grained; loose; moderately alkaline.

The solum is 8 to 25 inches thick. The area of mollic colors is 6 to 10 inches thick. Typically, Marlake soils have carbonates at the surface, but in some pedons the soils are leached of carbonates.

The A horizon is typically fine sandy loam, although the range includes loamy fine sand and loamy sand. Some pedons do not have an AC horizon. The C horizon is typically fine sand, but the range includes sand.

McCook Series

The McCook series consists of deep, well drained, moderately permeable soils on high bottom lands. The soils formed in silty and loamy stratified, calcareous alluvium. Slopes range from 0 to 1 percent.

McCook soils are similar to Craft soils and are commonly near Bridget, Craft, Glenberg, and Yockey soils. The Craft, Glenberg, and Yockey soils do not have a mollic epipedon. They are slightly lower on the landscape than the McCook soils. Bridget soils are not stratified and are on foot slopes. The Glenberg soils are loamy. The Yockey soils are somewhat poorly drained.

Typical pedon of McCook very fine sandy loam, 0 to 1 percent slopes, 100 feet north and 1,500 feet west of the southeast corner, sec. 30, T. 19 N., R. 48 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—8 to 14 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

AC—14 to 21 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C—21 to 60 inches; stratified very pale brown (10YR 7/3) and light brownish gray (10YR 6/2) very fine sandy loam, brown (10YR 5/3) and grayish brown (10YR 5/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum is 18 to 23 inches thick. The mollic epipedon is 12 to 16 inches thick.

The A horizon has value of 4 or 5 dry. It is typically very fine sandy loam, but the range includes loam. The A horizon is mildly alkaline or moderately alkaline. The AC horizon has value of 6 or 7 (4 through 6 moist). It is typically very fine sandy loam, although in some places it is loam or silt loam. The AC horizon is mildly alkaline or moderately alkaline. The C horizon has value of 4 through 6 moist.

Minatare Series

The Minatare series consists of deep, somewhat poorly drained, very slowly permeable soils on bottom lands. The soils formed in medium textured to fine textured alluvium high in sodium and soluble salts. Slopes range from 0 to 1 percent.

Minatare soils are similar to Janise soils and are commonly near Gering, Marlake, and Yockey soils. Janise, Gering, Marlake, and Yockey soils do not have a natric horizon. Janise soils are coarser textured than the Minatare soils. Gering soils are coarser textured, have less sodium, and have coarse sand and gravelly coarse sand at a depth of 20 to 40 inches. They and the Minatare soils are in similar positions on the landscape. The Marlake soils are very poorly drained, are sandy, and have less sodium. They are in depressions. Marlake and Yockey soils are not strongly alkaline in the solum. The silty Yockey soils are coarser textured, have less sodium, and are in positions on the landscape similar to those of the Minatare soils.

Typical pedon of Minatare loam, in an area of Minatare-Janise complex, 0 to 1 percent slopes, 300 feet north and 250 feet east of the southwest corner, sec. 28, T. 21 N., R. 52 W.

A—0 to 4 inches; gray (10YR 5/1 and 6/1) loam, very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) moist; weak fine and very fine granular structure; slightly hard, very friable; strong effervescence; very strongly alkaline; abrupt smooth boundary.

E—4 to 7 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; weak medium platy structure; hard, very friable; violent effervescence; very strongly alkaline; abrupt smooth boundary.

Bt1—7 to 16 inches; pale brown (10YR 6/3) silty clay, brown (10YR 4/3) moist; very dark grayish brown (10YR 3/2, moist) and dark brown (10YR 3/3, moist) faces of peds; moderate medium columnar structure parting to moderate very fine subangular blocky; hard, firm; violent effervescence; very strongly alkaline; clear smooth boundary.

Bt2—16 to 25 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak medium columnar structure parting to weak very fine subangular blocky; hard, friable; violent effervescence; very strongly alkaline; clear smooth boundary.

Ck1—25 to 35 inches; light gray (10YR 7/2) and white (10YR 8/2) sandy clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few fine masses of calcium carbonate; violent effervescence; strongly alkaline; clear smooth boundary.

Ck2—35 to 45 inches; light gray (10YR 7/2) loam, grayish brown (2.5Y 5/2) moist; common medium faint olive (5Y 5/4) and few fine distinct reddish yellow (7.5YR 6/8) mottles; massive; slightly hard, friable; few fine dark concretions (iron and manganese oxides); few fine white (10YR 8/1) masses of calcium carbonate; violent effervescence; strongly alkaline; clear smooth boundary.

2C—45 to 60 inches; very pale brown (10YR 7/3) coarse sand, pale brown (10YR 6/3) moist; common medium faint brownish yellow (10YR 6/6, moist) mottles; single grained; loose; moderately alkaline.

The solum is 24 to 31 inches thick.

The A and E horizons have hue of 10YR or 2.5Y, value of 5 through 7 (3 through 5 moist) and chroma of 1 or 2 dry or moist. The Bt horizon has value of 4 through 6 (3 through 5) moist and chroma of 2 or 3 dry or moist. The Bt horizon is typically silty clay and clay loam, but the range includes clay. In some pedons, thin strata of silty, loamy, and clayey alluvium are at a depth below 40 inches. The 2C horizon is typically coarse sand, but the range includes very gravelly coarse sand and gravelly sand.

Mitchell Series

The Mitchell series consists of deep, well drained, moderately permeable soils on valley foot slopes and on broad alluvial fans. The soils formed in colluvial-alluvial sediment that weathered from siltstone bedrock. Slopes range from 0 to 20 percent.

Mitchell soils are similar to Angora, Bridget, Keota, and Otero soils and are commonly near Bridget, Epping, Keota, Otero, and Sarben soils. Angora soils formed in loess and are on uplands. Bridget soils have a mollic epipedon. Keota soils are moderately deep to siltstone bedrock and commonly are higher on the landscape than the Mitchell soils. Otero soils are loamy. Epping soils are shallow to siltstone bedrock and are higher on the landscape. Sarben soils are loamy and are slightly higher on the landscape.

Typical pedon of Mitchell very fine sandy loam, 3 to 6 percent slopes, 2,450 feet north and 1,950 feet west of the southeast corner, sec. 1, T. 21 N., R. 52 W.

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

AC—9 to 15 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; soft, very friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C—15 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; violent effervescence; moderately alkaline.

The solum is 15 to 24 inches thick. The depth to carbonates ranges from 0 to 10 inches. The depth to siltstone bedrock is more than 40 inches.

The A horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but the range includes loam and silt loam. The A horizon is mildly alkaline or moderately alkaline.

The AC and C horizons have value of 6 through 8 (5 through 7 moist) and chroma of 2 or 3 dry or moist. The AC and C horizons are typically silt loam, but the range includes very fine sandy loam and loam.

Oglala Series

The Oglala series consists of deep, well drained, moderately permeable soils on uplands. The soils formed in material that weathered from fine-grained sandstone bedrock. Slopes range from 3 to 9 percent.

Oglala soils are similar to Alice, Bridget and Tripp soils and are commonly near Busher, Canyon, and Creighton soils. Bridget soils typically have carbonates higher in the profile than the Oglala soils. Bridget soils do not have a paralithic contact at a depth of 40 to 60 inches. They are on valley foot slopes. Alice soils contain more sand and do not have bedrock. They are on stream terraces. Tripp soils also do not have a paralithic contact at a depth of 40 to 60 inches. They are on stream terraces. Busher soils have more sand and less silt in the control section. Canyon soils are shallow and do not have a mollic epipedon. The Creighton soils are loamy and do not have a paralithic contact at a depth between 40 and 60 inches. The Busher, Canyon, and Creighton soils are in positions on the landscape similar to those of the Oglala soils.

Typical pedon of Oglala very fine sandy loam, in an area of Oglala-Canyon very fine sandy loams, 3 to 9 percent slopes, 2,450 feet north and 1,000 feet east of the southwest corner, sec. 19, T. 23 N., R. 51 W.

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

A—7 to 18 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak fine granular; slightly hard, friable; neutral; clear smooth boundary.

AC—18 to 27 inches; grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; soft, very friable; neutral; gradual smooth boundary.

C1—27 to 38 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; neutral; abrupt smooth boundary.

C2—38 to 54 inches; light gray (10YR 7/2) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; few fine sandstone pebbles; moderately alkaline; abrupt smooth boundary.

Cr—54 to 60 inches; white (10YR 8/1) weakly cemented fine-grained limy sandstone; violent effervescence.

The solum is 15 to 31 inches thick. The depth to carbonates ranges from 15 to 40 inches. The mollic epipedon is 7 to 20 inches thick. The depth to the fine-grained, weakly cemented, limy sandstone ranges from 40 to 60 inches or more.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but the range includes loam. The AC horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. The AC horizon is typically very fine sandy loam, but in some places it is loam or silt loam. The C horizon has value of 6 through 8 (5 or 6 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but the range includes silt loam and fine sandy loam.

Otero Series

The Otero series consists of deep, well drained soils on valley foot slopes and alluvial fans. Permeability is moderately rapid. The soils formed in loamy, calcareous colluvial-alluvial sediment that, in some places, has been modified by the wind. Slopes range from 0 to 20 percent.

Otero soils are similar to Mitchell, and Sarben soils and are commonly near Bridget, Mitchell, Otero Variant, Sarben, and Valent soils. Mitchell soils contain more silt and less sand in the control section than the Otero soils. Sarben soils are leached of carbonates typically to a depth of more than 30 inches. Bridget soils have a mollic epipedon. They and the Otero soils are in similar positions on the landscape. Otero Variant soils are somewhat poorly drained, have a seasonal high water table, and are lower on the landscape than the Otero soils. The Valent soils are sandy and are on hummocks and dunes higher on the landscape than the Otero soils.

Typical pedon of Otero very fine sandy loam, 0 to 3 percent slopes, 200 feet south and 2,040 feet east of the northwest corner, sec. 11, T. 21 N., R. 52 W.

Ap—0 to 8 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

AC—8 to 15 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; soft, very friable; slight effervescence; mildly alkaline; clear smooth boundary.

C—15 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum is 10 to 17 inches thick. Free carbonates are typically at the surface, but they are below a depth of

10 inches in some pedons. The solum is mildly alkaline or moderately alkaline.

The A horizon has value of 5 through 7 (3 through 5 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam or loamy very fine sand, but the range includes fine sandy loam, loamy fine sand, and loam. The AC horizon has value of 6 through 8 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but in some places it is loamy very fine sand or fine sandy loam. The C horizon has value of 6 through 8 (4 through 7 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, although the range includes fine sandy loam and loamy very fine sand.

Otero Variant

The Otero Variant consists of deep, somewhat poorly drained soils on valley foot slopes and on alluvial fans. Permeability is moderately rapid. The soils formed in loamy, calcareous colluvial-alluvial sediment. They receive seep water from irrigation canals. Slopes range from 0 to 2 percent.

Otero Variant soils are commonly near Mitchell, Otero, and Sarben soils. The Mitchell soils are well drained and have more silt and less sand. The well drained Otero soils do not have a seasonal high water table. The well drained Sarben soils are higher on the landscape on valley side slopes and on stream terraces. Sarben soils typically are leached of carbonates to a depth of more than 30 inches.

Typical pedon of Otero Variant very fine sandy loam, 0 to 2 percent slopes, 1,500 feet east and 150 feet south of the northwest corner, sec. 6, T. 20 N., R. 40 W.

Ap—0 to 10 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

AC—10 to 18 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—18 to 36 inches; light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; few fine faint brownish yellow (10YR 6/8, moist) mottles; massive; soft, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; light gray (10YR 7/2) very fine sandy loam, light brownish gray (10YR 6/2) moist; massive; soft, very friable; slight effervescence; moderately alkaline.

The solum is 8 to 20 inches in thickness. The depth to carbonates is 0 to 10 inches. The solum is mildly alkaline or moderately alkaline.

Mottles are present in the AC horizon of some pedons. The C horizon is typically very fine sandy loam, but the range includes loamy very fine sand, silt loam, and loam.

Platte Series

The Platte series consists of somewhat poorly drained soils that are shallow over gravelly coarse sand. Permeability is moderate over very rapid. The soils formed on bottom lands in loamy alluvium over sandy and gravelly material. Slopes range from 0 to 1 percent.

Platte soils are similar to Barney and Gering soils and are commonly near Barney, Gering, and Gothenburg soils. Barney soils are poorly drained, have a higher water table than that of Platte soils, and are on lower bottom lands. Gering soils are finer textured, are moderately deep to gravelly coarse sand, and are in positions similar to those of the Platte soils. Gothenburg soils have a lighter colored A horizon and are in lower positions on the landscape.

Typical pedon of Platte loam, 0 to 1 percent slopes, 900 feet south and 300 feet east of the northwest corner, sec. 19, T. 20 N., R. 50 W.

A—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—5 to 16 inches; stratified grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) fine sandy loam and very fine sandy loam, very dark grayish brown (10YR 3/2) and grayish brown (10YR 5/2) moist; few fine faint yellowish brown (10YR 5/6) mottles; massive; hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

2C2—16 to 60 inches; light gray (10YR 7/2) stratified gravelly coarse sand, light brownish gray (10YR 6/2) moist; single grained; loose; slight effervescence; moderately alkaline.

The solum is 5 to 12 inches thick. The depth to gravelly coarse sand ranges from 12 to 20 inches. Reaction is mildly alkaline or moderately alkaline.

The A horizon has value of 4 or 5 (2 or 3 moist). It is typically loam, but the range includes fine sandy loam and very fine sandy loam.

Sarben Series

The Sarben series consists of deep, well drained soils on valley side slopes and stream terraces. Permeability is moderately rapid. The soils formed in wind-reworked loamy and sandy material that weathered from sandstone bedrock. Slopes range from 1 to 17 percent.

Sarben soils are similar to Otero soils and are commonly near Alice, Otero, and Valent soils. Otero soils typically have free carbonates at the surface. They are on foot slopes and alluvial fans. Alice soils have a mollic epipedon and are on stream terraces. Valent soils are sandy and are in positions on the landscape similar to those of the Sarben soils.

Typical pedon of Sarben very fine sandy loam, 1 to 3 percent slopes, 1,000 feet south and 400 feet west of the northeast corner, sec. 27, T. 19 N., R. 52 W.

A—0 to 5 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; loose, very friable; neutral; clear smooth boundary.

AC—5 to 22 inches; pale brown (10YR 6/3) loamy very fine sand, brown (10YR 4/3) moist; weak medium prismatic structure; slightly hard, friable; neutral; gradual smooth boundary.

C1—22 to 31 inches; light brownish gray (10YR 6/2) loamy very fine sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; mildly alkaline; gradual smooth boundary.

C2—31 to 60 inches; light brownish gray (10YR 6/2) loamy very fine sand, dark grayish brown (10YR 4/2) moist; massive; loose, very friable; slight effervescence; mildly alkaline.

The solum is 12 to 26 inches thick. The depth to free carbonates typically ranges from 15 to 40 inches, but it is more than 40 inches in some pedons.

The A horizon has value of 5 or 6 dry and chroma of 2 or 3 dry or moist. It is very fine sandy loam or loamy very fine sand. The AC horizon has value of 4 or 5 moist and chroma of 2 or 3 dry or moist. Typically, it is loamy very fine sand, but the range includes very fine sandy loam. The AC horizon is neutral or mildly alkaline. The C horizon has value of 6 or 7 (4 through 6 moist) and chroma of 2 or 3 dry or moist. Typically, it is loamy very fine sand, although in some places it is very fine sandy loam. The C horizon is mildly alkaline or moderately alkaline.

Tassel Series

The Tassel series consists of shallow, well drained to excessively drained soils on uplands. Permeability is moderately rapid. The soils formed in loamy, sandy, calcareous material that weathered from fine-grained sandstone bedrock. Slopes range from 3 to 60 percent.

Tassel soils are similar to Canyon and Epping soils and are commonly near Angora, Busher, Canyon, and Dix soils. Canyon soils have more clay in the control section. Epping soils have more silt in the control section and formed in material that weathered from siltstone bedrock. Angora soils are deep, have more silt and less sand in the control section, and are higher on the landscape than the Tassel soils. Busher soils are deep, have a mollic epipedon, and have smoother, less steep slopes. Dix soils are excessively drained and have gravel in the underlying material. Busher and Dix soils are in

Figure 21.—A profile of Tassel loamy very fine sand, 20 to 50 percent slopes. The marker indicates the contact between soil material and sandstone. The depth is in feet.

positions on the landscape similar to those of the Tassel soils.

Typical pedon of Tassel loamy very fine sand, 20 to 50 percent slopes (fig. 21), 1,600 feet north and 1,100 feet west of the southeast corner, sec. 27, T. 22 N., R. 51 W.

A—0 to 6 inches; brown (10YR 5/3) loamy very fine sand, dark grayish brown (10YR 4/2) moist; weak very fine granular structure; soft, very friable; abundant fibrous roots; a few soft sandstone pebbles (14 percent); strong effervescence; mildly alkaline; clear smooth boundary.

C—6 to 13 inches; pale brown (10YR 6/3) loamy very fine sand, brown (10YR 4/3) moist; massive; soft, very friable; common fibrous roots; a few soft sandstone pebbles (19 percent); violent effervescence; mildly alkaline; abrupt wavy boundary.

Cr—13 to 23 inches; very pale brown (10YR 7/3), weakly cemented, fine-grained sandstone brown (10YR 5/3) moist; violent effervescence; moderately alkaline.

The solum is 3 to 9 inches thick. The depth to free carbonates ranges from 0 to 3 inches, and the depth to a paralithic contact ranges from 10 to 20 inches. The solum is mildly alkaline or moderately alkaline.

The A horizon has value of 4 through 6 (3 or 4 moist) and chroma of 2 or 3 dry or moist. It is typiclly loamy very fine sand or very fine sandy loam, but the range includes fine sandy loam and loamy fine sand. The C horizon has value of 6 or 7 (4 through 6 moist) and chroma of 2 or 3 dry or moist. It is typically loamy very fine sand, but the range includes very fine sandy loam and fine sandy loam that contains less than 12 percent clay.

Tripp Series

The Tripp series consists of deep, well drained, moderately permeable soils on stream terraces in major stream valleys. The soils formed mainly in loamy alluvium that in many areas has a component of loess. Slopes range from 0 to 9 percent.

Tripp soils are similar to Bridget and Oglala soils and are commonly near Alice, Bridget, Duroc, and Mitchell soils. Bridget soils have less horizonal development than the Tripp soils. They are calcareous at or near the surface and are on valley foot slopes and side slopes. Oglala soils have sandstone bedrock at a depth of 40 to 60 inches. The Oglala soils are on uplands. Alice soils have more sand and less silt and are in similar positions on the landscape. Duroc soils are finer textured, are pachic, and are on foot slopes. Mitchell soils do not have a mollic epipedon, are calcareous at or near the surface, and are on valley foot slopes.

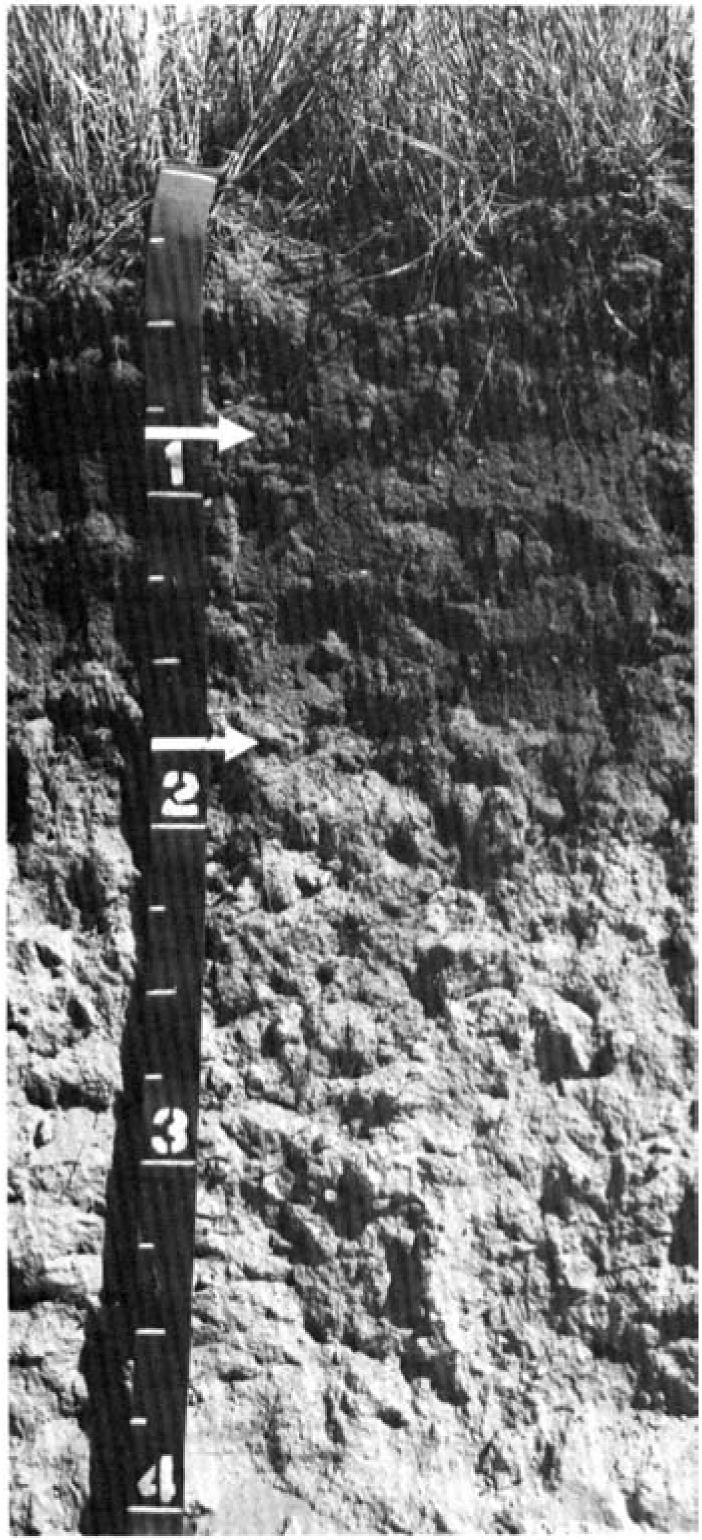


Figure 22.—A profile of Tripp very fine sandy loam, 1 to 3 percent slopes. This soil is deep. The upper and lower boundaries of the subsoil are indicated by the markers. The depth is in feet.

Typical pedon of Tripp very fine sandy loam, 1 to 3 percent slopes (fig. 22), 2,250 feet west and 1,300 feet north of the southeast corner, sec. 4, T. 21 N., R. 52 W.

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

Bw1—10 to 16 inches; brown (10YR 5/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, very friable; neutral; clear smooth boundary.

Bw2—16 to 22 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; neutral; clear smooth boundary.

Ck—22 to 30 inches; white (10YR 8/2) and light gray (10YR 7/2) very fine sandy loam, pale brown (10YR 6/3) moist; weak coarse subangular blocky structure; slightly hard, very friable; many soft powdery secondary calcium carbonate threads or accumulations; violent effervescence; moderately alkaline; clear smooth boundary.

C1—30 to 42 inches; light gray (10YR 7/2) very fine sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable; common soft powdery secondary calcium carbonate threads or accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—42 to 54 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

C3—54 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable; few fine pebbles; violent effervescence; moderately alkaline.

The solum is 20 to 40 inches thick. The depth to free carbonates ranges from 20 to 40 inches. The mollic epipedon is 7 to 20 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam but the range includes loam and silt loam. The A horizon is neutral or mildly alkaline. The B horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam but the range includes loam and silt loam. The B horizon is neutral or mildly alkaline. The C horizon has value of 7 or 8 (5 or 6 moist) and chroma of 2 or 3 dry or moist. It is typically very fine sandy loam, but in some places it is loam or silt loam. The C horizon is mildly alkaline or moderately alkaline.

Map units TrC2 and TrD2 have a surface layer that is lighter in color than the defined range for the Tripp series. This difference, however, does not alter the use or behavior of the soils.

Valent Series

The Valent series consists of deep, excessively drained, rapidly permeable soils on uplands and stream terraces. The soils formed in eolian sand. Slopes range from 0 to 50 percent.

Valent soils are similar to Valentine soils and are commonly near Dailey, Jayem, and Sarben soils. The Valentine soils have lower reaction in the lower part of the profile than the Valent soils. The Dailey soils are somewhat excessively drained. The Jayem soils are loamy. Both of these soils have a mollic epipedon and are in positions similar to those of the Valent soils. The Sarben soils are loamy and in lower positions on the landscape.

Typical pedon of Valent fine sand, rolling, 450 feet south and 1,700 feet west of the northeast corner, sec. 11, T. 19 N., R. 52 W.

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

AC—5 to 11 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (4/2) moist; single grained; loose, neutral; gradual smooth boundary.

C—11 to 60 inches; light brownish gray (10YR 6/2) sand, brown (10YR 5/3) moist; single grained; loose; mildly alkaline.

The solum is 3 to 10 inches thick. The depth to free carbonates ranges from 40 inches to more than 60 inches. The solum is neutral or mildly alkaline.

The A horizon has value of 5 or 6 (3 or 4 moist) and chroma of 2 or 3 dry or moist. It is typically fine sand or loamy fine sand, but the range includes loamy sand. The AC horizon has value of 5 or 6 and chroma of 2 or 3 dry or moist. It is typically fine sand, but the range includes loamy fine sand. Some pedons do not have an AC horizon. The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4 dry or moist. The C horizon is typically sand, but the range includes loamy fine sand and fine sand.

Valentine Series

The Valentine series consists of deep, excessively drained, rapidly permeable soils on sandhills. The soils formed in eolian sand. Slopes range from 3 to 60 percent.

Valentine soils are similar to the Valent soils and are commonly near Dunday and Els soils on the landscape. The Valent soils have higher reaction in the lower part of the profile than the Valentine soils. The Dunday soils have a mollic epipedon and are on nearly level to strongly sloping areas in lower positions on the landscape. The Els soils are somewhat poorly drained, have a seasonal high water table, and are in sandhill valleys in lower positions on the landscape.

Typical pedon of Valentine fine sand, rolling, 2,100 feet east and 800 feet south of the northwest corner, sec. 36, T. 21 N., R. 47 W.

A—0 to 5 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; loose; slightly acid; clear smooth boundary.

AC—5 to 15 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; weak coarse granular structure; loose; neutral; clear smooth boundary.

C—15 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; neutral.

The solum is 8 to 17 inches thick. It is slightly acid or neutral.

The A horizon has value of 4 through 6 (3 through 5 moist). It is typically fine sand, but the range includes loamy fine sand. The AC horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 through 4 dry or moist. It is typically fine sand, but in some places it is loamy sand.

Vetal Series

The Vetal series consists of deep, well drained soils in swales and on alluvial fans. Permeability is moderately rapid. The soils formed in local loamy alluvium. Slopes range from 0 to 3 percent.

Vetal soils are similar to Alice, Creighton, Duroc, and Jayem soils and are commonly near Jayem and Valent soils. The Alice and Creighton soils have a mollic epipedon less than 20 inches thick. The Duroc soils are silty and finer textured than the Vetal soils. The Jayem soils also have a mollic epipedon less than 20 inches thick, have convex slopes, and are in higher positions on the landscape. The Valent soils are sandy, do not have a mollic epipedon, and are on hummocks and dunes in higher positions on the landscape.

Typical pedon of Vetal fine sandy loam, 0 to 3 percent slopes, 2,400 feet east and 480 feet south of the northwest corner, sec. 16, T. 20 N., R. 48 W.

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

A—7 to 24 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable; few small pebbles; mildly alkaline; clear smooth boundary.

AC—24 to 41 inches; brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, friable; few small pebbles; mildly alkaline; clear smooth boundary.

C—41 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; few small pebbles; mildly alkaline.

The solum is 28 to 42 inches thick. The mollic epipedon ranges from 20 to 40 inches.

The A horizon has value of 4 or 5 dry. The AC horizon has value of 4 through 6 (3 or 4 moist) and chroma of 2 or 3 dry or moist. The C horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist.

Wildhorse Series

The Wildhorse series consists of deep, somewhat poorly drained, rapidly permeable soils in enclosed sandhill valleys and on low stream terraces. The soils formed in eolian sand and sandy alluvium. Slopes range from 0 to 2 percent.

Wildhorse soils are similar to Lisco soils and are commonly near Dunday, Els, Hoffland, and Lisco soils. The Lisco soils are loamy and on bottom lands. Dunday, Els, and Hoffland soils are not strongly alkaline or very strongly alkaline. The Dunday soils are excessively drained and on hummocks. The Els soils are in positions on the landscape similar to those of the Wildhorse soils. The Hoffland soils, which are in slightly lower positions on the landscape, are poorly drained and very poorly drained.

Typical pedon of Wildhorse sand, 700 feet east and 800 feet north of the southwest corner, sec. 27, T. 23 N., R. 47 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) sand, very dark grayish brown (10YR 3/2) moist; weak very fine granular structure; slightly hard, very friable; common fine roots; slight effervescence; strongly alkaline; abrupt smooth boundary.

A1—4 to 7 inches; light brownish gray (10YR 6/2) sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; few fine roots; slight effervescence; very strongly alkaline; clear smooth boundary.

AC—7 to 10 inches; light brownish gray (10YR 6/2) sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; few fine roots; strong effervescence; very strongly alkaline; clear smooth boundary.

C1—10 to 17 inches; light brownish gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; single grained; loose; few fine roots; strong effervescence; very strongly alkaline; gradual smooth boundary.

C2—17 to 25 inches; light brownish gray (10YR 6/2) sand, grayish brown (10YR 5/2) moist; few fine faint yellowish brown (10YR 5/4, moist) mottles; single grained; loose; few fine roots; strong effervescence; very strongly alkaline; clear smooth boundary.

C3—25 to 35 inches; light gray (10YR 7/2) sand, grayish brown (2.5Y 5/2) moist; few fine faint yellowish brown (10YR 5/4, moist) mottles; single grained; loose; few fine roots; violent effervescence; strongly alkaline; gradual smooth boundary.

C4—35 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (2.5Y 5/2) moist; few fine distinct yellowish brown (10YR 5/4, moist) mottles; single grained; loose; slight effervescence; strongly alkaline.

The solum ranges from 3 to 21 inches in thickness.

The A horizon has hue of 10YR, value of 4 through 6 (3 through 5 moist) and chroma of 1 or 2 dry or moist. It is typically sand or loamy fine sand, but the range includes fine sand and loamy sand. The A horizon is typically strongly alkaline or very strongly alkaline, although the range includes moderately alkaline. The AC horizon has hue of 10YR, value of 6 or 7 (4 or 5 moist), and chroma of 1 or 2 dry or moist. It is typically sand, but the range includes fine sand, loamy sand, and loamy fine sand. The AC horizon is typically very strongly alkaline, but the range includes strongly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 6 through 8 (5 or 6 moist), and chroma of 1 or 2 dry or moist to a depth of 30 inches and 1 through 3 below 30 inches. It is typically sand and fine sand; but some pedons have thin strata of loamy fine sand, fine sandy loam, loam, or loamy very fine sand. The C horizon is typically strongly alkaline or very strongly alkaline, but the range includes moderately alkaline.

Yockey Series

The Yockey series consists of deep, somewhat poorly drained, moderately permeable soils on bottom lands. The soils formed in stratified, loamy, calcareous alluvium. Slopes range from 0 to 2 percent.

Yockey soils are commonly near Craft, Gering, Glenberg, and Janise soils. The well drained Craft soils do not have mottles. Gering soils have coarse sand and gravelly coarse sand at a depth of 20 to 40 inches. The well drained Glenberg soils have more sand and less silt in the control section than the Yockey soils. The Janise soils have a very strongly alkaline B horizon. Gering, Glenberg, and Janise soils are in positions on the landscape similar to those of the Yockey soils.

Typical pedon of Yockey silt loam, 0 to 1 percent slopes, 2,500 feet west and 100 feet south of the northeast corner, sec. 13, T. 20 N., R. 51 W.

Ap—0 to 8 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

AC—8 to 15 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structure; slightly hard, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—15 to 32 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—32 to 60 inches; stratified light gray (10YR 7/2) and light brownish gray (10YR 6/2) silt loam and very fine sandy loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) moist; common medium distinct yellowish brown (10YR 5/4, moist) mottles; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

The solum ranges from 4 to 21 inches in thickness. Carbonates are typically at the surface; but in some pedons the upper 4 inches is leached of carbonates. The solum is mildly alkaline or moderately alkaline, although the range includes very strongly alkaline for the alkali phase.

The A horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically silt loam or very fine sandy loam, but the range includes loam, fine sandy loam, sandy loam, and loamy very fine sand. The AC horizon has value of 6 or 7 (4 or 5 moist) and chroma of 2 or 3 dry or moist. It is typically loam, but the range includes very fine sandy loam, loamy very fine sand, and silt loam. Some pedons do not have an AC horizon. The C horizon has value of 6 through 8 (4 through 6 moist) and chroma of 2 or 3 dry or moist. The C horizon is typically stratified silt loam and very fine sandy loam, although the range includes loam and loamy very fine sand. In some places, at a depth below 40 inches, the texture ranges from fine sandy loam to gravelly loamy very fine sand.

Formation of the Soils

Soil is produced by soil forming processes acting on material that has been deposited or that has accumulated as a result of geologic processes. The characteristics of a soil are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and has existed since accumulation, the plant and animal life on and in the soil, the relief, or lay of the land, and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural soil body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the parent material to change into a soil that has distinct horizons. Time, to some extent, always is necessary for differentiation of soil horizons. Usually a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effect on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other factors. The process of soil formation and development is continuous.

Parent Material

The parent material, which in Morrill County is mainly loess, eolian sand, alluvium, colluvium, and materials that weathered from bedrock (fig. 23), affects the mineralogical and chemical composition of the soil.

The loess in Morrill County is typically very pale brown, very friable, calcareous material on tablelands and, in places, on stream terraces. It is silty. It ranges to 5 feet or more in thickness. Keith soils formed in this material.

Soils on the sandhills and on dunes on the river valley terraces formed in eolian sand. The sand and fine sand in dunes is typically very pale brown or light brownish gray, single grained, and leached of carbonates. The Valentine and Els soils formed mainly in eolian sand on the sandhills. The Valent and Dailey soils formed in eolian sand on stream terraces and adjacent uplands.

The alluvium in Morrill County is on bottom lands and stream terraces. The most recent alluvium is in narrow drainageways and along the major streams where materials are deposited by flooding. The texture of the alluvium on bottom lands includes silt loam, very fine sandy loam, fine sandy loam, loamy fine sand, coarse sand, and gravelly sand. The texture of the alluvium on stream terraces is typically loam, very fine sandy loam, and fine sandy loam. The Bankard, Janise, and Yockey soils formed in alluvium on bottom lands. The Janise soils are strongly affected by alkali characteristics. The Alice and Tripp soils formed in alluvium on stream terraces.

Colluvial deposits are typically pale brown and very pale brown, very friable, calcareous material on valley foot slopes and alluvial fans. The material is typically very fine sandy loam, but the range includes loam and loamy very fine sand. Colluvium typically is mixed with alluvium. Bridget, Duroc, and Otero soils formed in colluvial-alluvial deposits.

Exposed rocks in Morrill County include siltstone, sandstone, and some beds of volcanic ash. The Busher, Jayem, Mitchell, and Sarben soils formed in material that weathered from bedrock. These soils are deep. The Busher soils formed in very friable, calcareous material that weathered from sandstone. Typically, the texture of the parent material is loamy very fine sand and very fine sandy loam. The Jayem soils formed in very friable and loose, leached material that weathered from sandstone. The Mitchell soils formed in very pale brown, very friable, calcareous colluvial-alluvial material that weathered from siltstone. Typically, the material is very fine sandy loam and silt loam. The Sarben soils formed in very friable, calcareous, wind-reworked material that weathered from sandstone. Typically, the material is loamy very fine sand and very fine sandy loam.

The Canyon and Tassel soils are shallow. They formed in calcareous material that weathered from sandstone. The Canyon soils formed in very friable, very fine sandy loam. The Tassel soils formed mainly in loamy very fine sand and very fine sandy loam.

Climate

Climate affects the formation of soils through its influence on the rate of weathering and reworking of parent material by rainfall, temperature, and wind. Because soil formation progresses slowly when the soil is dry, soils in arid regions generally are less well

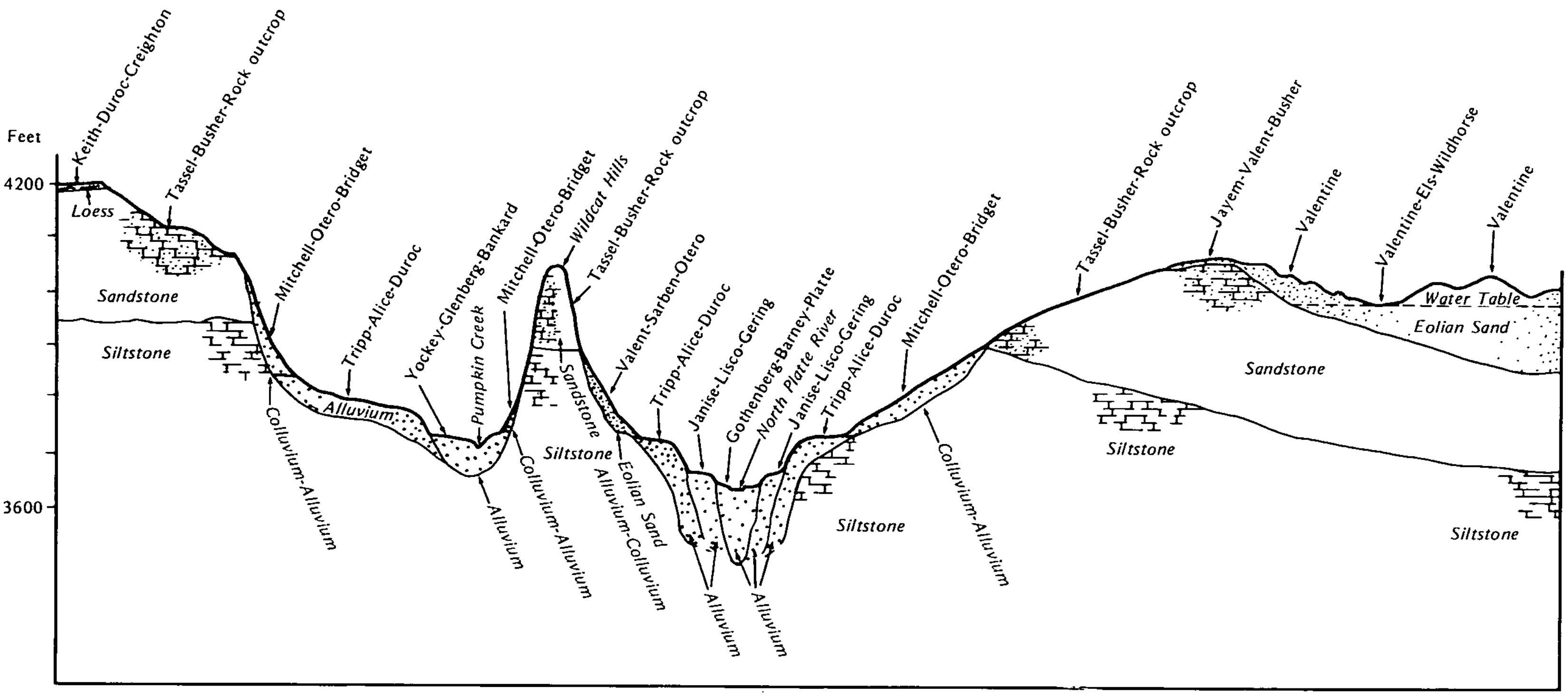


Figure 23.—A generalized cross section of Morrill County that shows the relationship of parent material, soil associations, and elevation.

developed than those in humid regions. The amount of moisture, the length of the growing season, and the prevailing temperature during the growing season affect the amount of vegetation, which is the principal source of organic matter in soils. These same factors directly affect the activity of the micro-organisms that convert organic matter to humus. Wind also is an important factor because it can either remove the top layer of soil or deposit a mantle of sediment on it.

Morrill County has a semiarid, continental climate that is characterized by wide day-to-day and season-to-season variations. The average annual temperature is 50° F. The average annual precipitation is about 16 inches. The frost-free season averages about 130 days, which is an adequate growing season for most common grains and forage crops. Frost penetrates to a depth of 2 to 3.5 feet. The prevailing wind is from the west or west-northwest in October through April. The windspeed is highest in the spring.

The differences in soils from one place to another are due to climate and other soil-forming factors. The temperature is slightly lower and the precipitation is slightly higher on the tablelands and the sandhills and at higher elevations in general. The depth to which carbonates are leached depends on the amount of precipitation and on the relief of the area. There is less leaching on steeper slopes because runoff is greater; and, generally, there is more leaching on the more permeable soils because of the associated higher infiltration rate. The soils on south- and west-facing slopes are usually warmer and drier because of exposure to the sun; and, correspondingly, they are subject to less leaching.

Wind has had an effect on many soils in this county. The dune areas are the result of the wind reworking sandy soil material. These areas have been stabilized only long enough for minimal soil development. Many eolian materials are aligned with the prevailing wind direction, and wind continues to have an effect on the soils. The reworking of some soils through the removal of the entire surface layer or of silty material and organic matter by wind action continues on soils that have plant cover removed. Erosion caused by water and wind can prevent the development of a thick surface layer, especially on steeper slopes.

Plant and Animal Life

After the parent material was deposited, bacteria, fungi, and other simple forms of life invaded it. After a time, prairie grasses began to grow, and fibrous roots penetrated the upper few feet of the soil. The roots of the grasses helped to keep the soils productive by bringing water and solutes from the deeper horizons, thus contributing soluble minerals, such as calcium, iron, phosphorous, nitrogen, and sulfur. The plant roots not only obtained useful nutrients for plants but also helped to develop better soil structure and helped to aerate the soil. Plants return to the surface some of the soluble minerals that have been leached.

When plants decay, micro-organisms act upon the organic matter and decompose it into stable humus. These micro-organisms include bacteria, nematodes, and protozoa. Nitrogen-fixing bacteria in nodules on the roots of certain legumes remove nitrogen from the air; when the bacteria die, the nitrogen becomes available in the soil. Fungi and such small animals as millipedes, spiders, and mites also act upon organic matter and decompose it into humus. Earthworms, insects, and small burrowing animals affect the formation of soils by mixing and working the organic and mineral matter. This mixing and working speeds soil development and makes the soil more friable.

The accumulation of decayed organic matter gradually darkens the color of the surface layer and changes its physical and chemical characteristics. The soil is enriched with plant nutrients from the decaying organic matter. Tilth is improved, permeability to air and water is established, and water movement into the soil and through the soil is increased. In Morrill County, Marlake soils have high organic matter content; whereas, Bankard, Mitchell, Otero, Valent, Valentine, and Yockey soils have low organic matter content.

Relief

Relief, or the lay of the land, influences soil formation mainly through its effect on drainage, runoff, and vegetative growth. The degree of slope, shape of the surface, and permeability of the soil determine the rate of runoff, the internal drainage, and the moisture content of the soils. Internal drainage and availability of moisture are important factors in the formation of the horizons of a soil.

The nearly level and gently sloping soils on uplands have stronger development and more distinct soil horizons than the strongly sloping to steep soils on uplands. Where lime and plant nutrients are leached to greater depths, a B horizon develops. The Keith soils in Morrill County have a distinct subsoil.

On steep slopes, where runoff is rapid and little moisture penetrates the soil, development of the soil is slower than on the more gentle slopes. Erosion removes the surface soil almost as fast as it is formed, and lime and other elements are not leached so deeply. In Morrill County, the Canyon and Tassel soils have little development of a soil profile other than a slightly darkened, thin surface layer.

The rolling soils on the sandhills have slow runoff. The soils are excessively drained and have rapid permeability. Here, carbonates have been leached very deeply. Soil horizons are weakly developed and indistinct because the coarse sandy material is highly resistant to chemical weathering. The Valentine soils are an example of these weakly developed soils.

The nearly level and gently sloping soils on stream terraces have distinct soil horizons. Generally, the lime is leached from the normal plant root zone. In Morrill County, the Alice and Tripp soils have a moderate degree of development in their profile.

Nearly level soils on bottom lands may receive water and sediment through flooding from adjacent creeks and streams. In these areas some of the soils are somewhat poorly drained because of slow runoff or a seasonal high water table. The water table provides additional moisture to the root zone by capillary action. The moisture in the soil affects the mineral and chemical composition and the kind and amount of vegetation, which in turn influences soil development. In Morrill County, the Janise and Yockey soils are somewhat poorly drained.

Differences in the lay of the land slow some processes of horizon differentiation and hasten others. Ordinarily, the soils on uplands and stream terraces that have gentle slopes have a thick solum and distinct horizons, and the soils that have steeper slopes have a thinner solum and less distinct horizons.

Time

Time is required for the formation of a mature soil. Mature or old soils have a thick, dark surface layer and a distinct subsoil. Soil materials in which these soils formed have been in place long enough for climate, plant and animal life, and relief to alter the parent material. These soils are approaching equilibrium with their environment and are considered to be mature or old soils. In Morrill County, Keith soils are examples of mature soils with well-expressed horizons.

Most of the soils on stream terraces have a more well-defined sequence of genetic horizons than the soils on bottom lands. The Alice and Tripp soils are on stream terraces. The Bankard and Yockey soils are on bottom lands, where the alluvium has been in place for a shorter period of time; so, generally, there has been insufficient time for these soils to form distinct horizons.

The degree of profile development depends on the intensity of the different soil-forming factors, on the length of time they have been active, and on the nature of the parent material. Differences in the length of time that geologic materials have been exposed to the weathering processes are, therefore, commonly reflected in the distinctness of horizons in the soil profile.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

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

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

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

Argillic horizon. A diagnostic subsurface horizon. An illuvial horizon in which layer-lattice silicate clays have accumulated by illuviation to a significant extent. The illuvial horizon generally has distinctly finer texture than the overlying eluvial horizon or the underlying parent material.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Break. Abrupt change in surface slope. Typically, a slope change from a tableland to a large stream valley. Includes an area of dissected steep and very steep slopes in the landscape.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

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.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

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

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the 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.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. 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.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

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

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Depth class. In this survey, the total thickness of soil material over gravelly coarse sand or bedrock is given in the following classes:

	Inches
Very shallow	0 to 10
Shallow	10 to 20
Moderately deep	20 to 40
Deep	more than 40

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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

Eco-fallow. The application of herbicides on uncropped land to control weeds and allow storage of moisture in the soil for growth of a later crop. A combination of summer fallow, minimum tillage and herbicide application that leaves a protective cover of crop residue. A system of conservation tillage.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most 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.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

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

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 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.

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

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

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 upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, 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) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

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

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

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

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.

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

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

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

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.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

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

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mollic epipedon. A diagnostic surface horizon that consists of mineral soil material. It has structure, dark color and low chroma, organic matter content of at least 1.0 percent and is normally 7 to 10 or more inches thick, moist 3 months or more of most years when warm and fertile.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that typically has columnar structure and a sodium absorption ration greater than 13.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Organic matter content. The amount of organic matter in soil material. The classes used in this survey are:

	Percent
Very low	less than 0.5
Low	0.5 to 1.0
Moderately low	1.0 to 2.0
Moderate	2.0 to 4.0
High	4.0 to 8.0

Pachic soil. A soil with an overthickened epipedon or surface horizon. It is typically a soil with a mollic epipedon greater than 20 inches thick and has a regular decrease of organic matter content with increasing depth.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Paralithic contact. A boundary between soil and continuous coherent underlying material. The material underlying a paralithic contact is typically partly consolidated sandstone or siltstone that roots cannot enter. The material can be dug with difficulty with a spade.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

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.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

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.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

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.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

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

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

	Percent
Nearly level	0 to 1, 0 to 2
Very gently sloping	1 to 3, 0 to 3
Gently sloping	3 to 6, 1 to 6, 0 to 6
Strongly sloping	6 to 9, 3 to 9
Moderately steep	9 to 20, 9 to 17, 6 to 20
Steep	3 to 30
Very steep	20 to 50, 6 to 50, 11 to 60, 20 to 60

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na! to Ca!! + Mg!!. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A 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.

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

Strip cropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, EB) below the surface layer.

Summer fallow. The application of herbicide or tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB and EB horizons. Includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plant. Seedbed preparation for row crops by scalping the area of the old row and pushing soil and residue aside, leaving a protective cover of crop residue on and mixed in the surface layer between the crop rows. Seedbed preparation and planting are completed in the same operation. A system of conservation tillage.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.