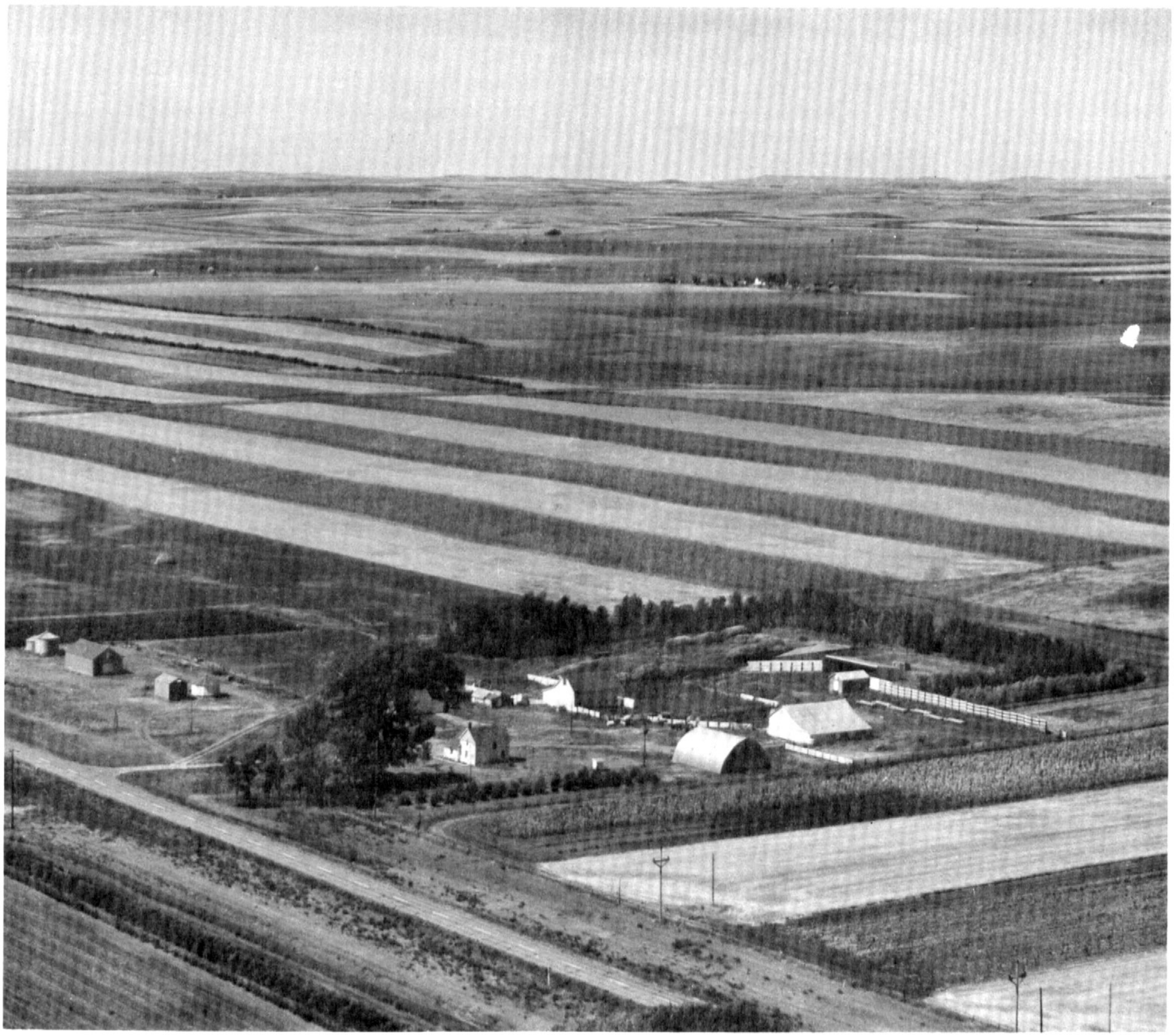
United States
Department of
Agriculture

Soil
Conservation
Service

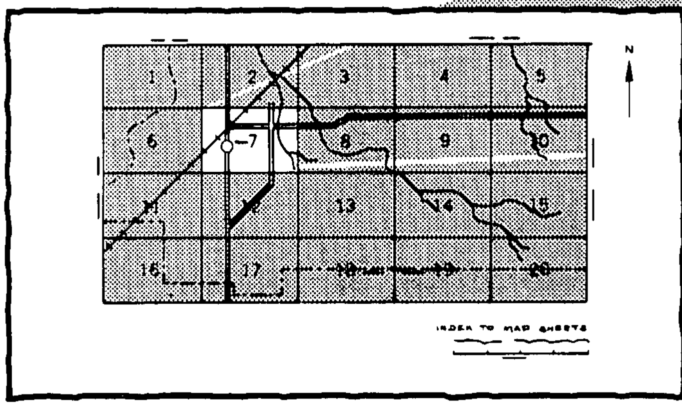
In cooperation with
North Dakota Agricultural
Experiment Station,
North Dakota Cooperative
Extension Service, and
North Dakota State Soil
Conservation Committee

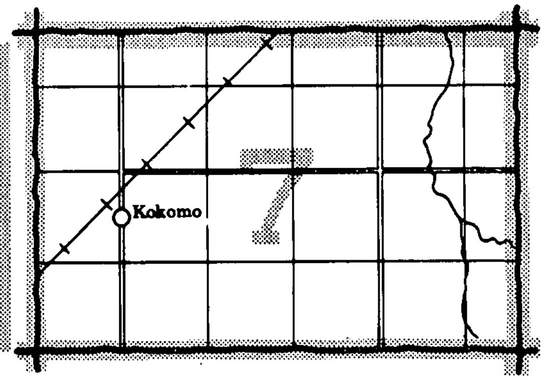
Soil Survey of Adams County, North Dakota



HOW TO USE

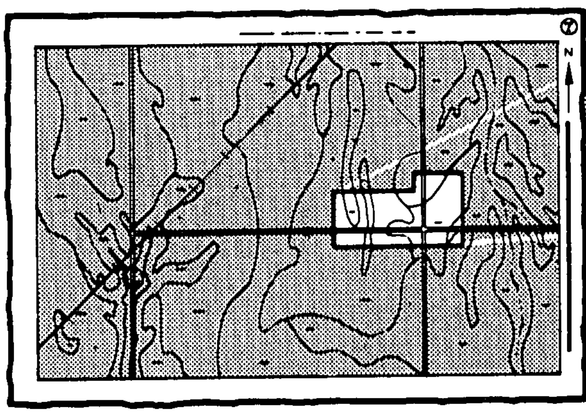
1. Locate your area of interest on the "Index to Map Sheets"

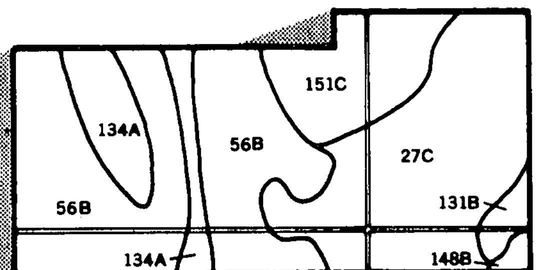




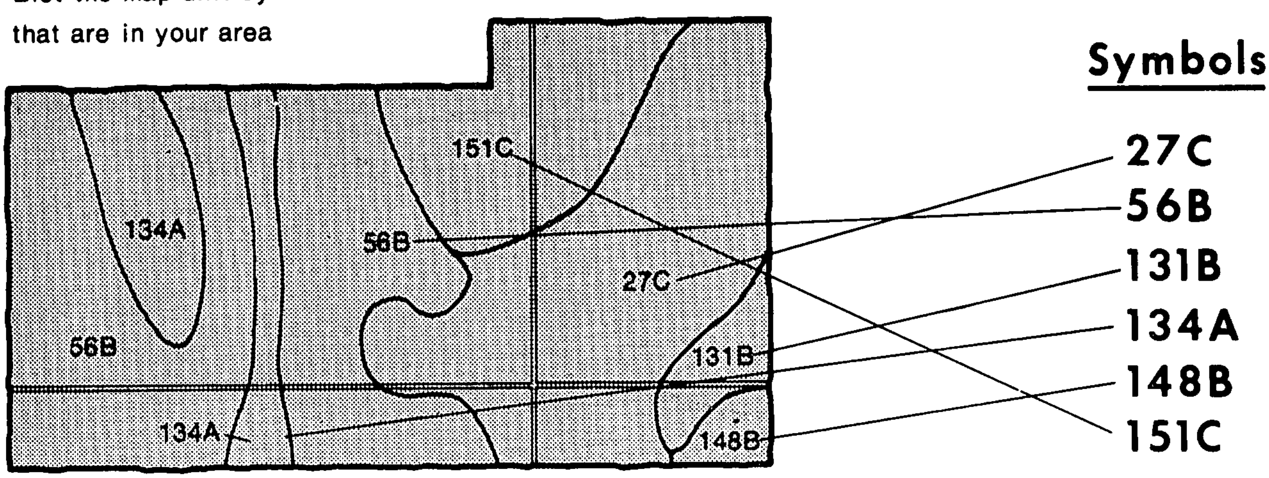
2. Note the number of the map sheet and turn to that sheet.

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



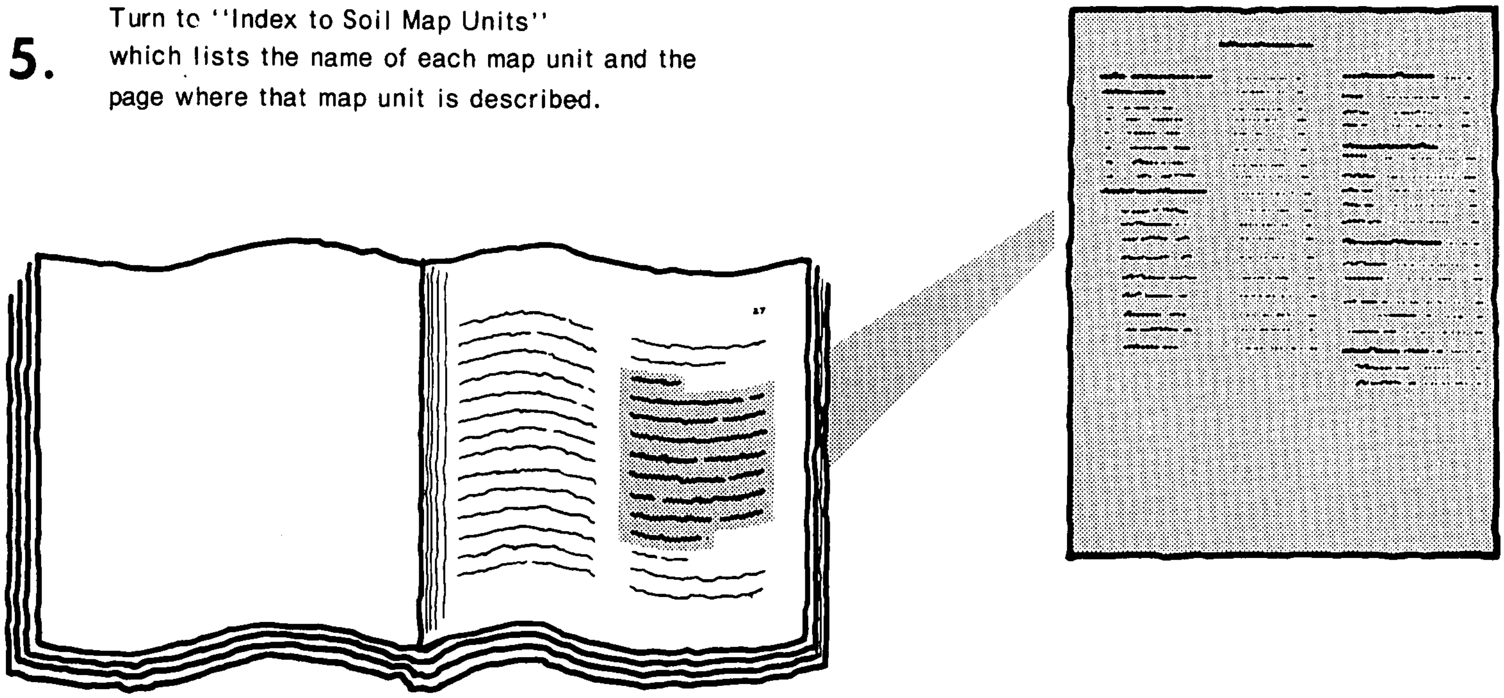


4. List the map unit symbols that are in your area

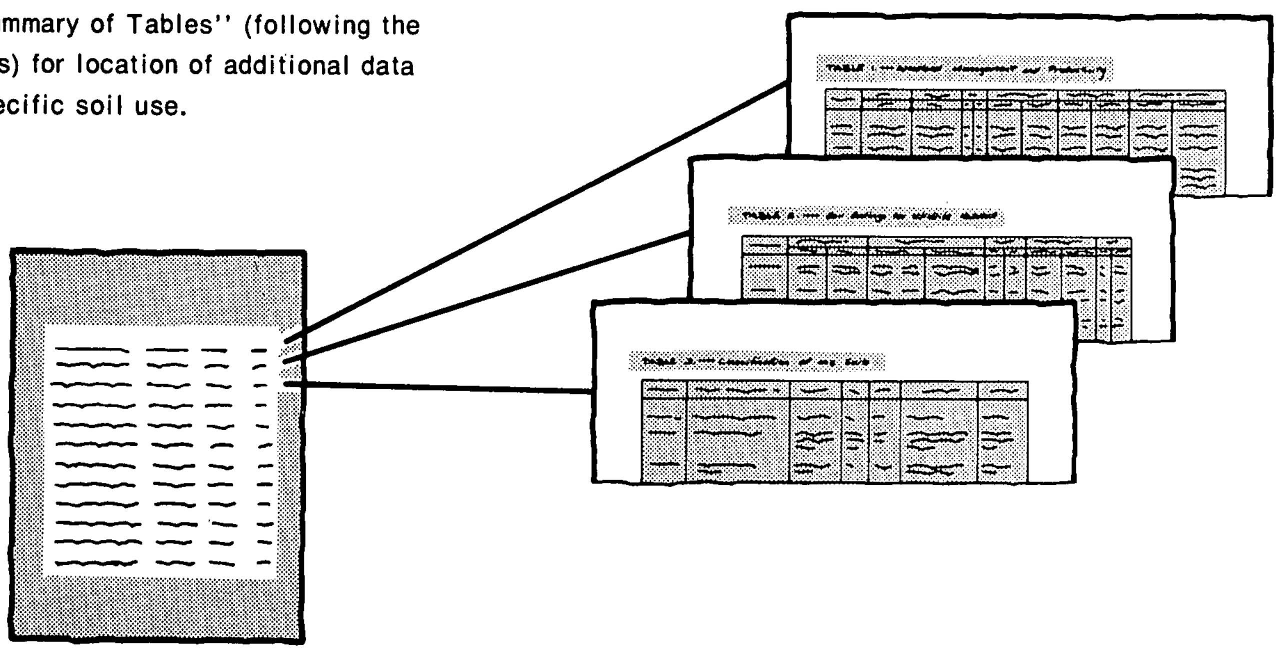


THIS SOIL SURVEY

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 other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, handicap, or age.

Major fieldwork for this soil survey was completed in 1980. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service, the North Dakota Agricultural Experiment Station, the North Dakota Cooperative Extension Service, and the North Dakota State Soil Conservation Committee. Financial assistance was provided by the Adams County Board of Commissioners. The survey is part of the technical assistance furnished to the Adams County Soil Conservation District.

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

Cover: A farmstead in an area of Arnegard soils. The Parshall soils in the center of the picture are protected from soil blowing by stripcropping and field windbreaks. The Heil soils in the background are used for hay and range.

Contents

Soil Series

Issued September 1987

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Adams 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 ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

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

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

August J. Dornbusch, Jr.
State Conservationist
Soil Conservation Service

Soil Survey of
Adams County, North Dakota

By Michael G. Ulmer and Jay F. Conta, Soil Conservation Service

Fieldwork by James A. Clapper, Jay F. Conta, Ronald W. Luethe, and Francis J. Wilhelm, Soil Conservation Service; Thomas Champa, Aileen Steinolfson, and Dwight Teske, North Dakota State Soil Conservation Committee; and Lawrence P. Haugen and Richard Kukowski, professional soil classifiers

Map finishing by David W. Hickcox and Steve S. Kranick, North Dakota State Soil Conservation Committee

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the North Dakota Agricultural Experiment Station,
North Dakota Cooperative Extension Service,
and North Dakota State Soil Conservation Committee

Adams County is in the southwestern part of North Dakota (fig. 1). It has a total area of 633,600 acres, of which 632,775 acres is land and 825 acres is water. The county is bounded on the south by South Dakota, on the east by Sioux and Grant Counties, on the north by Hettinger and Slope Counties, and on the west by Bowman County. The county seat and largest town is Hettinger, which is in the south-central part of the county.

The county is part of the Rolling Soft Shale Plain of the Northern Great Plains Spring Wheat Region (*18*). It is within the Missouri River Basin. Buffalo, Cedar, Chantapeta, Duck, Hidden Wood, and Timber Creeks flow through the county in a northwesterly to southeasterly direction. The North Fork of the Grand River touches the southwest corner of the county. Among the prominent landmarks in the county are Cedar Butte, Square Butte, Twin Butte, Whetstone Butte, Wolf Butte, and Rocky Ridge.

Farming and ranching are the main economic enterprises. The principal crops are spring wheat and other small grain. About 57 percent of the county is cropland, and 35 percent is range. Irrigation is limited to small areas adjacent to the major streams.

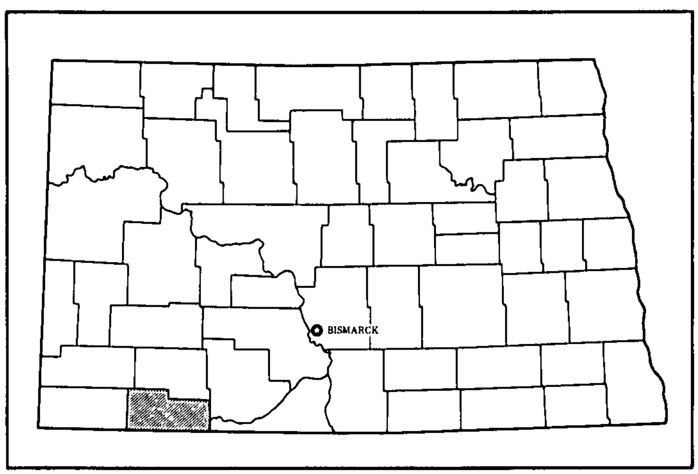


Figure 1.—Location of Adams County in North Dakota.

The soils in the county are mostly deep or moderately deep and are suited to cultivated crops. Some contain salts or sodium, and most are highly susceptible to soil blowing and water erosion unless they are protected.

The first soil survey of a part of Adams County was published in 1908 (*15*). The entire area of the county was included in a survey published in 1910 (*11*). A general soil survey of the county was published in 1968 (*14*). The present survey updates the earlier surveys. It provides additional information and larger scale maps, which show the soils in more detail.

General Nature of the County

This section provides general information about Adams County. It describes the climate; physiography, relief, and drainage; history and development; and natural resources.

Climate

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

Adams County has a continental, semiarid climate. Summers are usually quite warm. They are characterized by frequent spells of hot weather and occasional cool days. The county is very cold in winter, when artic air frequently surges over the area. Most precipitation falls during the warm period and is normally heaviest in late spring and early summer. Winter snowfall is normally not too heavy, and it is blown into drifts, so that much of the ground is free of snow.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Hettinger in the period 1951 to 1980. 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 17 degrees F, and the average daily minimum temperature is 6 degrees. The lowest temperature on record, which occurred at Hettinger on January 29, 1966, is -37 degrees. In summer the average temperature is 68 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on July 11, 1980, is 106 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 annual precipitation is about 16 inches. Of this, 13 inches, or about 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 10 inches. The heaviest 1-day rainfall during the period of record was 4.82 inches at Hettinger on June 6, 1967. Thunderstorms occur on about 34 days each year. Hail falls in scattered small areas during summer thunderstorms.

The average seasonal snowfall is about 29 inches. The greatest snow depth at any one time during the period of record was 28 inches. On the average, 48 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year. Blizzards occur several times each winter.

The average relative humidity in midafternoon is about 70 percent. Humidity is higher at night, and the average at dawn is about 75 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the west-northwest. Average windspeed is highest, 12 miles per hour, in spring.

Physiography, Relief, and Drainage

Adams County is in the unglaciated Missouri Plateau region of the Great Plains physiographic province. It is characterized by generally low relief. Gentle slopes are interrupted by low buttes or ridges. The landscape is a moderately dissected, rolling plain that is underlain mainly by calcareous shales and sandstones. Some strongly dissected areas of sharp local relief and steep slopes border the stream valleys.

Elevation at Hettinger is 2,670 feet. The highest point in the county is 3,150 feet at Whetstone Butte. The lowest point is 2,350 feet, in the bed of the Cedar Creek, at the east border of the county.

The Sheep-Timber Creek watershed drains the northeastern part of the county. The Plum Creek watershed drains the southeastern part. The Cedar-Duck-Chanta Peta watershed drains the central part. The Flat Creek watershed drains the south-central part. The Lightening-Willow-Buffalo watershed drains the southwestern part.

History and Development

Indian tribes were the first people to visit what is now Adams County. The Sioux were the dominant tribe, but several others passed through the area for trading or hunting purposes. This area was at one time claimed by traders and trappers for Spain and later for France. The Louisiana Purchase in 1803 opened up this region for exploration by the United States. General George Custer passed through the area on his way to assess the rumors of gold in the Black Hills of South Dakota in 1874.

In the early 1900's, only a few scattered ranches were established on the open range. Settlement increased quickly after 1907 because of the advent of the Milwaukee Railroad. Adams County was established on April 17, 1904 (*4*). The town of Hettinger was named the county seat. The county was named for John Quincy

Adams, a townsite agent for the Milwaukee Railroad and a distant relative of the former President (*4*).

A high proportion of the first settlers in Adams County came from settled states to the east, predominantly Minnesota and Iowa (*4*). Later waves of immigration brought German-Russian people from southern Russia and people of Scandanavian descent to the county. The settlers found the prairie soils fertile and productive.

Townsites were established in the southern part of the county as the railroad advanced westward. Hettinger was the first town established in Adams County. Town lots were sold in October of 1907 (*4*). The towns of Reeder and Haynes were established in 1908 and Bucyrus in 1909.

According to the Bureau of the Census, the population of the county was 5,407 in 1910. It reached an all-time high of 5,593 in 1920. It decreased because of economic hardship, severe droughts, and soil erosion in the 1930's, but it has slowly increased since then. It was 3,584 in 1980. Hettinger had a population of 1,292 in 1930 and 1,739 in 1980. In 1980, Reeder had a population of 355, Haynes a population of 58, and Bucyrus a population of 32.

Agriculture began in Adams County with cattle ranching on the open range (*4*). Before 1880, Texas cattle were herded through the area on their way north to graze along the Missouri River. As homesteaders fenced claims and plowed up the prairie, the open range disappeared. Some ranchers moved farther west, while others filed homestead claims and started farming.

By 1901, the Bureau of the Census reported that there were 1,344 farmsteads in the county. Many of the early homesteaders were forced to abandon their claims because of a lack of water, drought, hail, and tornadoes. At first, horses were used to break the sod, but they were later replaced by steam tractors (*4*). The number of farms decreased from 929 in 1930 to 380 in 1980. As the number of farms decreased, the average size of the farms or ranches increased. The average size is currently 1,450 acres. Generally, the livestock ranches are considerably larger than the diversified farms.

The major crop is hard red spring wheat, which yielded an average of 18.3 bushels per acre per year during the period 1976 to 1980 (*9*). Other commonly grown crops are barley, flax, oats, corn, rye, sunflowers, and winter wheat. The crops grown primarily for livestock are corn, alfalfa, tame grasses, and sweet clover. The corn is cut for silage.

The Adams County Soil Conservation District was organized and approved on April 20, 1948. The Soil Conservation Service furnishes technical assistance to the district.

Natural Resources

The water supply in Adams County comes from both surface and subsurface sources. The main sources of surface water are local streams, such as Cedar, Duck, and Flat Creeks. The main source of ground water is the Fox Hills and Basal Hell Creek aquifer system (*10*). The water is generally unsuitable as irrigation water. It is mainly clear but in some areas is yellow. It has some hydrogen sulfide, which causes an odor, but chlorination usually helps to correct this problem. The yield from the Fox Hills and Basal Hell Creek aquifer ranges from 1 to 100 gallons per minute. The other aquifer systems in the county do not provide suitable irrigation water.

Other natural resources in Adams County are coal and coal products. The county has a total estimated coal reserve of 1.9 billion tons (*19*). Lignite has been mined in the county on a commercial basis for many years. Also, coallike raw material is mined in the Haynes area for use in the manufacture of gas and oil-drilling mud (*19*).

The county is a part of the Williston Basin, a region in which oil exploration has been extensive. Most of the producing oil wells are to the west or north of the county (*19*). Many holes have been drilled in the county, but no producing oil wells have been located to date.

The county has sand and gravel deposits that are suitable for asphaltic concrete mixtures or for graveling road surfaces (*19*). The gravel deposits are on stream terraces. They vary in quality.

Porcelanite (scoria) is another surfacing material used on some county roads, especially in the parts of the county having no deposits of gravel. The suitability of the scoria for use on roads varies a great deal. The hardest deposits are the best suited.

Some of the clay from flat-topped buttes is suitable for the manufacture of brick, pottery, powder, and tile (*19*). This clay has a high kaolinitic clay content. A small factory on the northwest edge of Hettinger used local clay to make bricks for many years.

How This Survey Was Made

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

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

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

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

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

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

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

Map Unit Composition

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

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

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

Survey Procedures

The general procedures used to make this survey are described in the Soil Conservation Service's National Soils Handbook and the *Soil Survey Manual* (*16*). *The Major Soils of North Dakota* (*13*), *Geology of Adams and Bowman Counties, North Dakota* (*8*), *Soil Survey of the Morton Area, North Dakota* (*15*), and *Soil Survey of Western North Dakota* (*11*) were among the references used.

All soil mapping was done on field sheets developed from high-altitude aerial photographs taken in 1975. The scale of the field sheets was 1:20,000, or 3.168 inches to the mile. The detail of these field sheets was checked against older aerial photographs and in some instances against topographic maps.

The soil delineations were drawn on the field sheets as the soil scientists traversed the land on foot, by a pickup with a mounted hydraulic soil probe, or by three-wheel, all-terrain cycles. The traverses were across all the major landforms and were at an interval close enough for the soil scientists to locate contrasting soil areas of about 3 to 5 acres. The soils were examined to a depth of 3 to 5 feet, depending upon the soil type. Soil properties, including color, texture, structure, horizonation, content of salts and stones, and depth to soft bedrock, were examined.

Landscapes with similar soils were delineated on the field sheets as a map unit. The soil scientists characterized all map units by transecting representative areas. A transect is a series of detailed examinations of a delineation. It determines the composition of various soil types and soil properties. One transect was made for each 1,000 acres of each map unit. The transect data were analyzed by a statistical method explained by R.W. Arnold (*3*). This statistical analysis indicates that the map unit composition given in the map unit descriptions is at least 90 percent accurate.

Each map unit was documented by at least three pedon descriptions for each soil series identified in its name. Soil characterization or engineering test data from 25 soil pedons were sampled from 1977 to 1982. The soil analyses were made by the North Dakota State University, Soil Department, and by the National Soil Survey Laboratory at Lincoln, Nebraska. The analyses made at the National Soil Survey Laboratory were also used in a research project concerning unsaturated hydraulic conductivity in soils having different textures (*12*).

General Soil Map Units

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

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

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

Soil Descriptions

Moderately Deep, Shallow, and Deep, Moderately Coarse Textured and Coarse Textured Soils on Uplands

These soils formed in material weathered from sandstone bedrock and in alluvium. They are on uplands. They make up about 31 percent of the county. The principal use is range, but scattered areas of cropland are throughout the associations. These associations are poorly suited to cultivated crops and well suited to range.

1. Vebar-Flasher-Parshall Association

Moderately deep, shallow, and deep, nearly level to very steep, well drained and somewhat excessively drained soils

This association consists of nearly level to very steep soils on foot slopes, side slopes, ridges, knobs, and buttes in the dissected uplands. Most areas are drained by well defined, entrenched, intermittent streams. Slope ranges from 1 to 70 percent.

This association makes up about 16 percent of the county. It is about 27 percent Vebar soils, 20 percent Flasher and similar soils, 15 percent Parshall and similar soils, and 38 percent minor soils (fig. 2).

The nearly level to moderately sloping, well drained Vebar soils are on side slopes below the Flasher soils and above the Parshall soils. They are moderately deep. Typically, they have a fine sandy loam surface layer and a fine sandy loam and loamy fine sand subsoil. Soft sandstone is at a depth of about 34 inches.

The gently sloping to very steep, somewhat excessively drained Flasher soils are on ridges, knobs, and buttes above the Vebar and Parshall soils. They are shallow. Typically, they have a loamy fine sand or fine sandy loam surface layer and a loamy fine sand substratum. Soft sandstone is at a depth of about 17 inches.

The nearly level and gently sloping, well drained Parshall soils are in swales on foot slopes below the Vebar and Flasher soils. They are deep. Typically, they are fine sandy loam throughout.

The most extensive minor soils in this association are the Belfield, Daglum, Harriet, and Regan soils. The nearly level and gently sloping Belfield soils are on the upper foot slopes. They have a silt loam surface layer and a silty clay and silty clay loam subsoil. The nearly level and gently sloping Daglum soils are on the lower foot slopes. They have a silt loam surface layer and a clay and clay loam subsoil. The level Harriet soils are on narrow flood plains and are poorly drained. They have a clay subsoil. The level and nearly level Regan soils are in swales and drainageways and are poorly drained. They have accumulated lime within 16 inches of the surface.

This association is used mainly as range. It is well suited to this use. Some of the less sloping areas are used for cultivated crops. The rooting depth is limited by the soft bedrock in the Flasher and Vebar soils. The hazards of soil blowing and water erosion are severe. They are the main concerns in managing cultivated areas. Droughtiness and slope also are concerns. The main concerns in managing range are locating watering areas and distributing grazing so that the abundance of the key native plants is maintained.

The Vebar and Parshall soils are suited to cultivated crops and building site development. The Flasher soils are generally unsuited to septic tank absorption fields. The Parshall soils are well suited and the Vebar soils best suited to a mound type of absorption field.

2. Beisigl-Vebar-Flasher Association

Moderately deep and shallow, nearly level to very steep, somewhat excessively drained and well drained soils

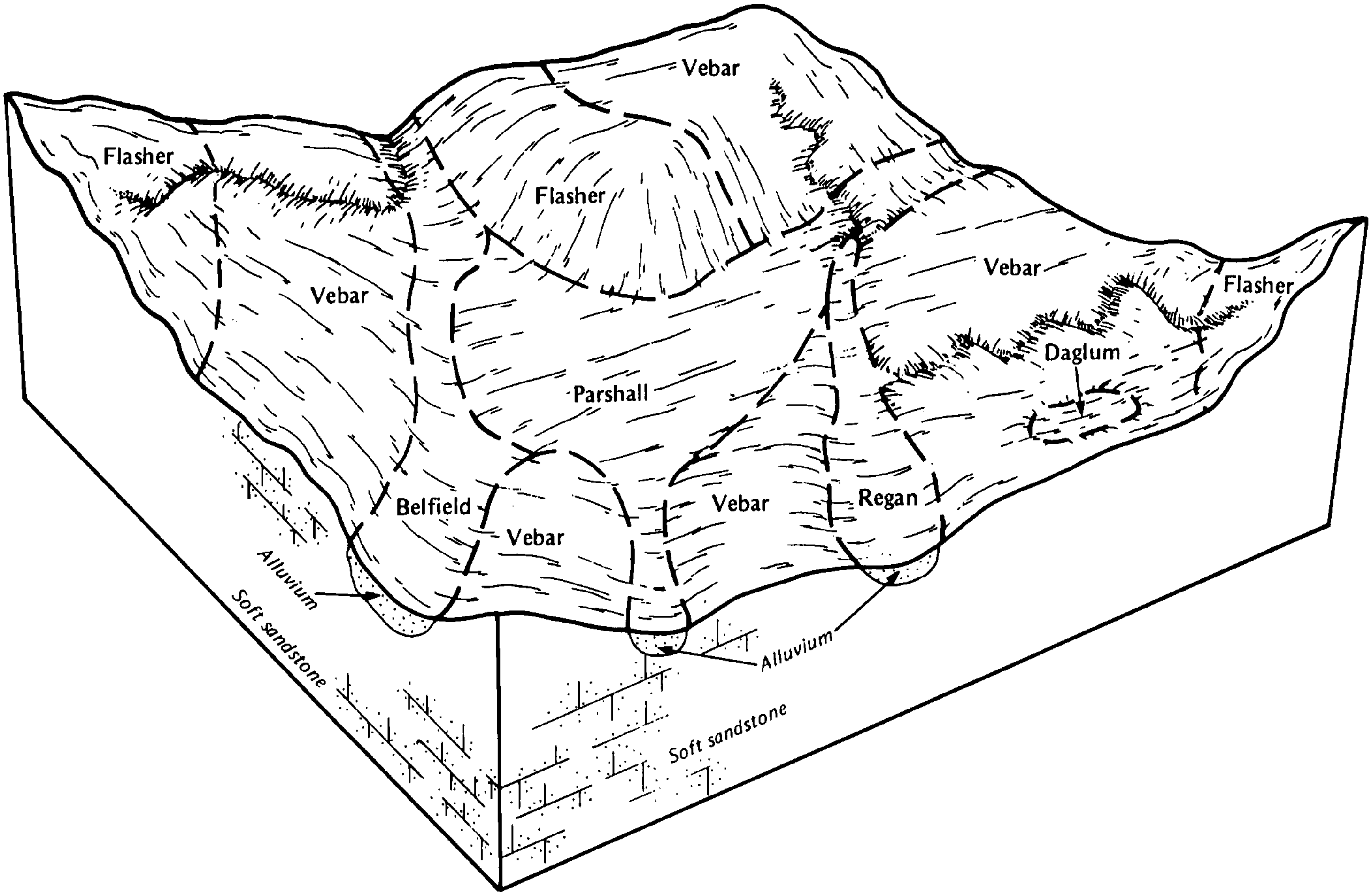


Figure 2.—Typical pattern of soils and underlying material in the Vebar-Flasher-Parshall association.

This association consists of nearly level to very steep soils on side slopes, knolls, foot slopes, hills, buttes, and ridges in the dissected uplands. Most areas are drained by well defined, entrenched, intermittent streams. Slope ranges from 1 to 70 percent.

This association makes up about 15 percent of the county. It is about 35 percent Beisigl and similar soils, 18 percent Vebar soils, 18 percent Flasher and similar soils, and 29 percent minor soils.

The nearly level to very steep, somewhat excessively drained Beisigl soils are on the upper side slopes below the Flasher soils and above the Vebar soils. They are moderately deep. Typically, they have a loamy fine sand surface layer and subsoil. Soft sandstone is at a depth of about 27 inches.

The nearly level to moderately sloping, well drained Vebar soils are on the lower side slopes below the Beisigl and Flasher soils. They are moderately deep. Typically, they have a fine sandy loam surface layer and a fine sandy loam and loamy fine sand subsoil. Soft sandstone is at a depth of about 34 inches.

The gently sloping to very steep, somewhat excessively drained Flasher soils are on ridges and knobs above the Beisigl and Vebar soils. They are shallow. Typically, they have a loamy fine sand or fine sandy loam surface layer and a loamy fine sand substratum. Soft sandstone is at a depth of about 17 inches.

The most extensive minor soils in this association are the Belfield, Parshall, and Regan soils. The nearly level and gently sloping Belfield soils are on foot slopes. They have a silt loam surface layer and a silty clay and silty clay loam subsoil. The nearly level and gently sloping Parshall soils are in swales and along drainageways. They are deep and are dark to a depth of 16 inches or more. The level and nearly level Regan soils are in swales and along drainageways and are poorly drained. They have accumulated lime within 16 inches of the surface.

This association is used mainly as range. In some of the less sloping areas, it is used for cultivated crops. It is suited to these uses. The rooting depth is limited by the soft bedrock. The hazards of soil blowing and water erosion are severe. They are the main concerns in managing cultivated areas. Droughtiness and the slope also are concerns. The main concerns in managing range are locating watering areas and distributing grazing so that the abundance of the key native plants is maintained.

The Vebar soils and the less sloping Beisigl soils are suited to building site development. The Flasher soils are generally unsuited to septic tank absorption fields. The less sloping Beisigl and Vebar soils are best suited to a mound type of absorption field.

Deep and Moderately Deep, Medium Textured and Moderately Fine Textured, Dominantly Alkali Soils on Uplands

These soils formed in alluvium and in material weathered from shale and soft bedrock. They are on uplands. They make up about 25 percent of the county. The principal use is cropland, but scattered areas of range are throughout the associations. These associations are suited to cultivated crops and well suited to range.

3. Belfield-Amor-Daglum Association

Deep and moderately deep, nearly level to strongly sloping, well drained and moderately well drained soils

This association consists of nearly level to strongly sloping soils on foot slopes, broad flats, and side slopes in the uplands. Most areas are drained by well defined, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 12 percent of the county. It is about 25 percent Belfield soils, 20 percent Amor and similar soils, 17 percent Daglum and similar soils, and 38 percent minor soils (fig. 3).

The nearly level and gently sloping, well drained, alkali Belfield soils are in swales, on foot slopes, and on broad flats below the Amor soils and in areas intermingled with or slightly above the Daglum soils. They are deep. Typically, they have a silt loam surface layer, a silty clay and silty clay loam subsoil, and a silty clay loam substratum.

The gently sloping to strongly sloping, well drained Amor soils are on side slopes above the Belfield and Daglum soils. They are moderately deep. Typically, they have a loam surface layer and subsoil. Soft sandstone and siltstone are at a depth of about 36 inches.

The nearly level and gently sloping, well drained and moderately well drained, alkali Daglum soils are in

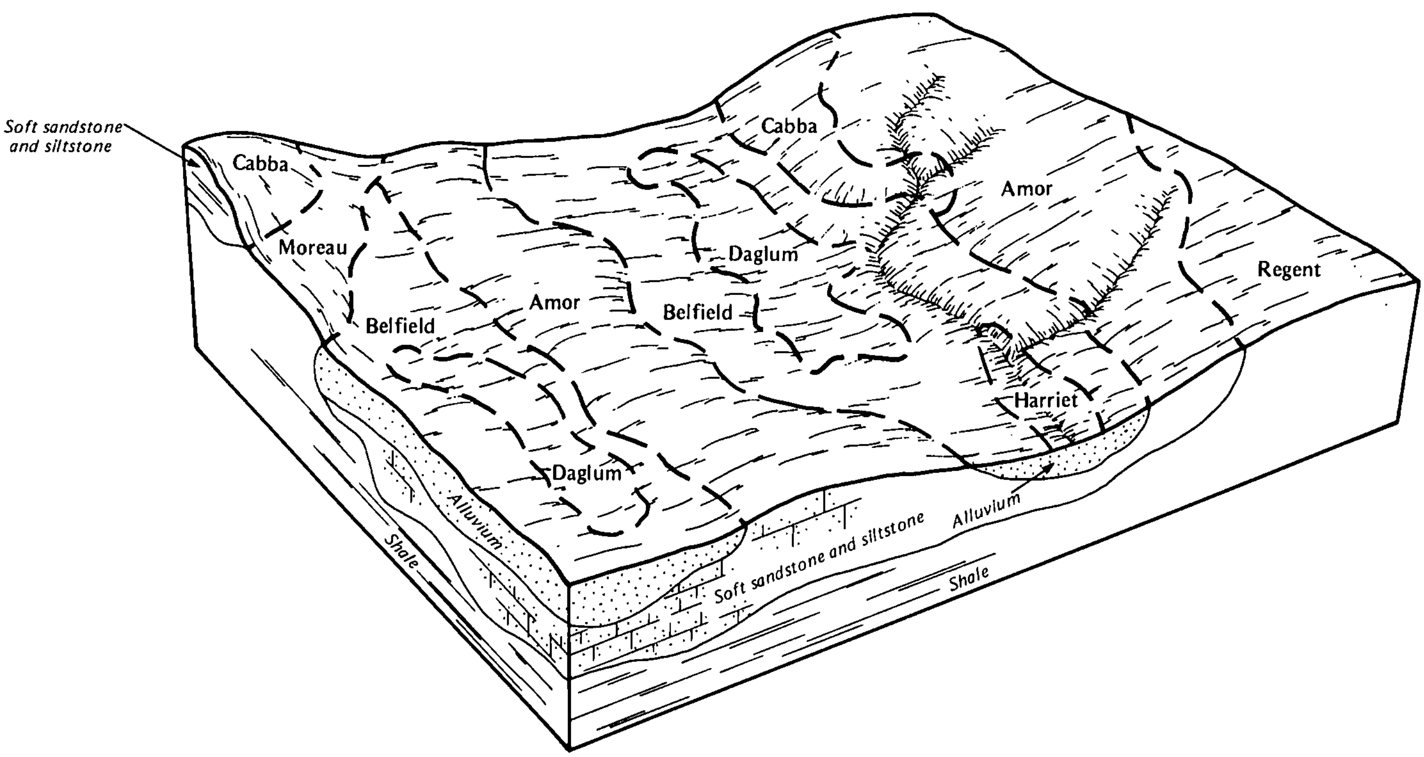


Figure 3.—Typical pattern of soils and underlying material in the Belfield-Amor-Daglum association.

swales on foot slopes and on broad flats below the Amor soils and in areas intermingled with or slightly below the Belfield soils. They are deep. Typically, they have a silt loam surface layer and subsurface layer and a clay and clay loam subsoil and substratum.

The most extensive minor soils in this association are the Cabba, Grail, Harriet, Moreau, Regent, and Shambo soils. The strongly sloping to very steep Cabba soils are on ridges and hills. They have soft bedrock at a depth of 10 to 20 inches. The nearly level Grail soils are in swales. They are dark to a depth of 16 inches or more. The level Harriet soils are on narrow flood plains and are poorly drained. They have a clay subsoil. The gently sloping Moreau soils are on side slopes. They have a silty clay surface layer. The gently sloping and moderately sloping Regent soils are on side slopes. They have a silty clay loam surface layer. The nearly level and gently sloping Shambo soils are on foot slopes. They are deep and do not have a sodic subsoil.

This association is used mainly for cultivated crops. In some areas it is used as range. It is suited to these uses. The rooting depth is limited by the soft bedrock in the Amor soils and the dense, alkali subsoil in the Belfield and Daglum soils. The hazards of soil blowing and water erosion are the main concerns in managing cultivated areas. The content of sodium salts and a moderate available water capacity also are concerns. The main concern in managing range is distributing grazing so that the abundance of the key native plants is maintained.

The major soils are suited to building site development. The Belfield soils are suited to septic tank absorption fields. The Amor and Daglum soils are best suited to a mound type of absorption field.

4. Belfield-Shambo-Regent Association

Deep and moderately deep, nearly level to moderately sloping, well drained soils

This association consists of nearly level to gently rolling soils on foot slopes, side slopes, and flats in the dissected uplands. Most areas are crossed by well defined, intermittent streams. Slope ranges from 1 to 9 percent.

This association makes up about 2 percent of the county. It is about 28 percent Belfield soils, 28 percent Shambo and similar soils, 9 percent Regent and similar soils, and 35 percent minor soils.

The nearly level and gently sloping Belfield soils are in swales on foot slopes and on broad plains. They are deep. Typically, they have a silt loam surface layer, a silty clay and silty clay loam subsoil, and a silty clay loam substratum.

The nearly level and gently sloping Shambo soils are on flats and foot slopes. They are deep. Typically, they have a loam surface layer, a sandy clay loam and fine sandy loam subsoil, and a fine sandy loam substratum.

The gently sloping and moderately sloping Regent soils are on side slopes above the Belfield and Shambo soils. They are moderately deep. Typically, they have a silty clay loam surface layer and a silty clay and silty clay loam subsoil. Shale is at a depth of about 36 inches.

The most extensive minor soils in this association are the Amor, Daglum, and Rhoades soils. The gently sloping to strongly sloping Amor soils are on side slopes. They are moderately deep and have a loam surface layer and subsoil. The nearly level and gently sloping Daglum and Rhoades soils are in swales on the lower foot slopes. Their subsoil is sodic and contains salts.

This association is used mainly for cultivated crops. In a few areas it is used as range. It is suited to these uses. The rooting depth is limited by the soft bedrock in the Regent soils and by the alkali subsoil in the Belfield soils. The hazards of soil blowing and water erosion are the main concerns in managing cultivated areas. The main concern in managing range is distributing grazing so that the abundance of the key native plants is maintained.

The major soils are suited to building site development and septic tank absorption fields. The Amor soils are best suited to a mound type of absorption field.

5. Belfield-Daglum-Rhoades Association

Deep, nearly level and gently sloping, well drained and moderately well drained soils

This association consists of nearly level and gently sloping soils on flats and foot slopes in the uplands. Most areas are drained by well defined, intermittent streams. Slope ranges from 1 to 6 percent.

This association makes up about 11 percent of the county. It is about 20 percent Belfield soils, 18 percent Daglum and similar soils, 18 percent Rhoades and similar soils, and 44 percent minor soils (fig. 4).

The well drained, alkali Belfield soils are on flats and the upper foot slopes above the Daglum and Rhoades soils. Typically, they have a silt loam surface layer, a silty clay and silty clay loam subsoil, and a silty clay loam substratum.

The well drained and moderately well drained, alkali Daglum soils are in swales on the lower foot slopes below the Belfield soils and in areas slightly above or intermingled with the Rhoades soils. Typically, they have a silt loam surface layer and subsurface layer and a clay and clay loam subsoil and substratum.

The well drained and moderately well drained, alkali Rhoades soils are in swales on foot slopes below the Belfield soils and in areas slightly below or intermingled with the Daglum soils. Typically, they have a silt loam surface layer, a silty clay subsoil, and a substratum of silt loam and silty clay loam.

The most extensive minor soils in this association are the Amor, Beisigl, Cabba, Flasher, Heil, and Sinnigam soils. The nearly level to moderately sloping Amor soils

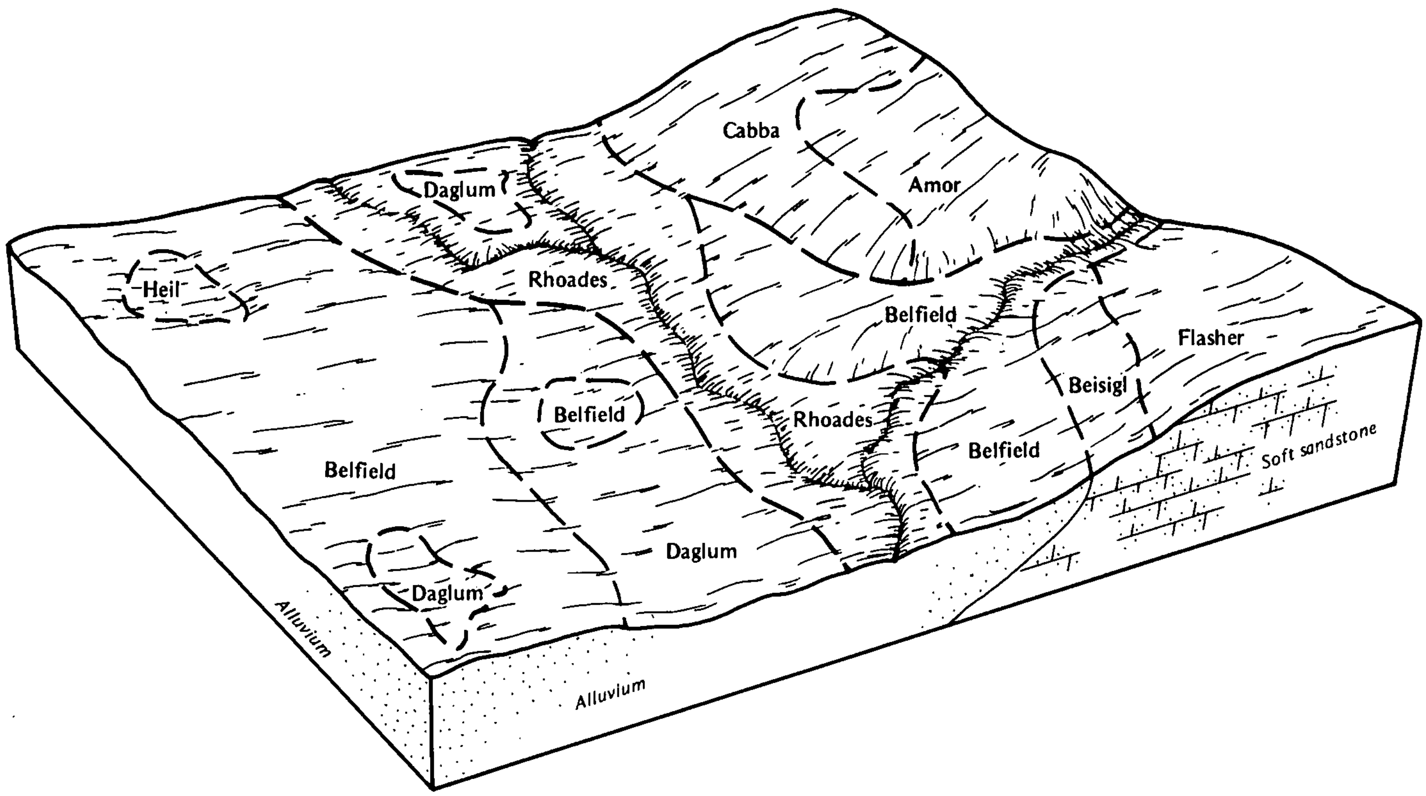


Figure 4.—Typical pattern of soils and underlying material in the Belfield-Daglum-Rhoades association.

are on side slopes. They are moderately deep and have a loam surface layer and subsoil. The nearly level to steep Beisigl soils are on side slopes. They are moderately deep and have a loamy fine sand surface layer and subsoil. The moderately sloping to very steep Cabba and Flasher soils are on ridges and hills. They are underlain by soft bedrock at a depth of 10 to 20 inches. The level Heil soils are in depressions and are poorly drained. The nearly level and gently sloping Sinnigam soils are on the tops of low buttes. They have hard bedrock at a depth of 10 to 20 inches.

This association is used mainly for cultivated crops. In some areas it is used as range. It is suited to these uses in most areas. The Rhoades soils, however, are generally unsuited to cultivated crops. The hazards of soil blowing and water erosion are the main concerns in managing cultivated areas. Other management concerns are the content of sodium salts, a restricted rooting depth caused by the alkali subsoil, and a moderate or low available water capacity in the Daglum and Rhoades soils. The main concerns in managing for range are locating good watering sites and distributing grazing so that the abundance of the key native plants is maintained.

The major soils are suited to building site development. The Belfield soils are better suited to septic tank absorption fields than the Daglum and Rhoades soils, which are best suited to a mound type of absorption field.

Moderately Deep, Deep, and Shallow, Medium Textured and Moderately Fine Textured Soils on Uplands

These soils formed in material weathered from shale, siltstone, and sandstone and in alluvium. They are on uplands. They make up about 29 percent of the county. The principal use is cropland, but scattered areas of range are throughout the associations. These associations are suited to cultivated crops and well suited to range.

6. Amor-Regent-Belfield Association

Moderately deep and deep, nearly level to strongly sloping, well drained soils

This association consists of nearly level to strongly sloping soils on foot slopes, side slopes, ridges, and knobs in the uplands. Most areas are crossed by well defined, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 18 percent of the county. It is about 38 percent Amor and similar soils, 21 percent Regent and similar soils, 18 percent Belfield soils, and 23 percent minor soils (fig. 5).

The gently sloping to strongly sloping Amor soils are on side slopes above the Belfield soils. They are moderately deep. Typically, they have a loam surface layer and subsoil. Soft sandstone and siltstone are at a depth of about 36 inches.

The gently sloping and moderately sloping Regent soils are on side slopes above the Belfield soils. They are moderately deep. Typically, they have a silty clay loam surface layer and a silty clay and silty clay loam subsoil. Shale is at a depth of about 36 inches.

The nearly level and gently sloping Belfield soils are in swales on foot slopes below the Amor and Regent soils. They are deep. Typically, they have a silt loam surface layer, a silty clay and silty clay loam subsoil, and a silty clay loam substratum.

The most extensive minor soils in this association are the Cabba, Daglum, and Parshall soils. The gently sloping to very steep Cabba soils are on hills and ridges. They have soft bedrock at a depth of 10 to 20 inches. The nearly level and gently sloping Daglum soils are in swales on the lower foot slopes. Their subsoil is sodic and contains salts. The nearly level and gently sloping Parshall soils are in swales on foot slopes. They are deep and have a fine sandy loam surface layer and subsoil.

This association is used mainly for cultivated crops. In a few areas it is used as range. It is suited to these uses. The rooting depth is limited by the soft bedrock in the Amor and Regent soils and by the alkali subsoil in the Belfield soils. The hazards of soil blowing and water erosion are the main concerns in managing cultivated areas.

The major soils are suited to building site development. The Belfield soils are suited to conventional septic tank absorption fields, and the Amor and Regent soils are suited to a mound type of absorption field.

7. Amor-Cabba-Belfield Association

Moderately deep, shallow, and deep, nearly level to very steep, well drained soils

This association consists of nearly level to very steep soils on foot slopes, side slopes, hills, ridges, and knobs in the dissected uplands. Most areas are drained by well

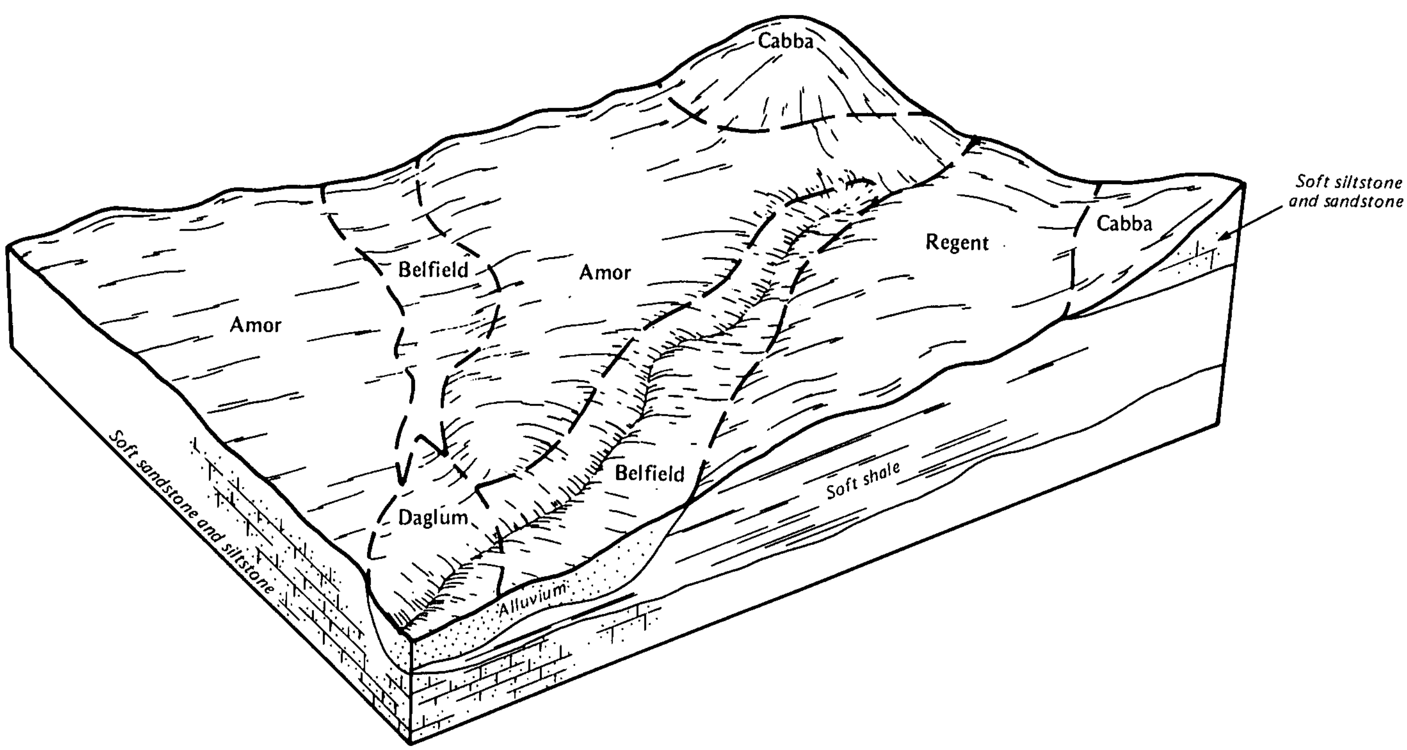


Figure 5.—Typical pattern of soils and underlying material in the Amor-Regent-Belfield association.

defined, intermittent streams. Slope ranges from 1 to 70 percent.

This association makes up about 11 percent of the county. It is about 22 percent Amor and similar soils, 22 percent Cabba and similar soils, 10 percent Belfield soils, and 46 percent minor soils.

The gently sloping to moderately steep Amor soils are on side slopes below the Cabba soils and above the Belfield soils. They are moderately deep. Typically, they have a loam surface layer and subsoil. Soft sandstone and siltstone are at a depth of about 36 inches.

The moderately sloping to very steep Cabba soils are on ridges, hills, and knobs above the Amor and Belfield soils. They are shallow. Typically, they have a silt loam or loam surface layer and a silt loam and loam substratum. Soft bedrock is at a depth of about 17 inches.

The nearly level and gently sloping Belfield soils are in swales on foot slopes below the Cabba and Amor soils. They are deep. Typically, they have a silt loam surface layer, a silty clay and silty clay loam subsoil, and a silty clay loam substratum.

The most extensive minor soils in this association are the Beisigl, Daglum, Savage, and Straw soils. The gently sloping to steep Beisigl soils are on knolls and side slopes. They are moderately deep and have a loamy fine sand surface layer and subsoil. The nearly level and gently sloping Daglum soils are in swales on the lower foot slopes. Their subsoil is sodic and contains salts. The gently sloping Savage soils are on the upper foot slopes. They are deep and have a clay loam surface layer. The level and nearly level Straw soils are on flood plains. They have a loam surface soil and substratum.

This association is used mainly as cropland. In the more sloping areas, it is generally used as range. It is suited to these uses. The rooting depth is limited by the soft bedrock in the Amor and Cabba soils and by the alkali subsoil in the Belfield soils. The hazards of soil blowing and water erosion are the main concerns in managing cultivated areas. Other management concerns are the slope and a moderate or low available water capacity in the Amor and Cabba soils.

The Amor and Belfield soils and the less sloping Cabba soils are suited to building site development. The Belfield soils are suited to conventional septic tank absorption fields, and the Amor soils are best suited to a mound type of absorption field. The Cabba soils are generally unsuited to septic tank absorption fields.

Deep, Medium Textured and Moderately Coarse Textured Soils on Flood Plains and Terraces

These soils formed in alluvium on flood plains and terraces. They make up about 15 percent of the county. The principal use is cropland, but scattered areas of range are throughout the associations. These associations are well suited to cultivated crops and range.

8. Bowdle-Parshall-Harriet Association

Deep, level to gently sloping, well drained and poorly drained soils

This association consists of level to gently sloping soils on flood plains and terraces. Most areas are crossed by shallow, intermittent drainageways that are perpendicular to the streams. Slope ranges from 0 to 6 percent.

This association makes up about 5 percent of the county. It is about 31 percent Bowdle and similar soils, 23 percent Parshall and similar soils, 15 percent Harriet and similar soils, and 31 percent minor soils.

The level to gently sloping, well drained Bowdle soils are on terraces. Typically, they have a loam surface layer, a loam and gravelly sandy loam subsoil, and a substratum of very gravelly loamy sand and stratified sand and gravel.

The nearly level and gently sloping, well drained Parshall soils are on terraces. Typically, they are fine sandy loam throughout.

The level, poorly drained, alkali, saline Harriet soils are on flood plains and terraces. Typically, they have a loam surface layer, a clay subsoil, and a clay loam substratum.

The most extensive minor soils in this association are the Belfield, Daglum, and Straw soils. The nearly level and gently sloping Belfield and Daglum soils are in swales. They have a sodic subsoil. The level and nearly level Straw soils are on flood plains. They have a loam surface soil and substratum.

This association is used mainly for cultivated crops, hay, or pasture. In most areas it is suited to these uses and to range. The Harriet soils, however, are generally unsuited to cultivated crops. The hazards of soil blowing and flooding are the main concerns in managing cultivated areas. Other management concerns are the content of sodium salts, wetness, and flooding in areas of the Harriet soils and a restricted rooting depth caused by the sand and gravel in the Bowdle soils.

The Bowdle and Parshall soils are suited to building site development, but the Harriet soils are generally unsuited because of the flooding. The Parshall soils are suited to septic tank absorption fields, but the Harriet soils are generally unsuited because of the flooding. The Bowdle soils are best suited to a mound type of absorption field.

9. Straw-Parshall-Bowdle Association

Deep, level to gently sloping, well drained soils

This association consists of level to gently sloping soils on flood plains and terraces. Most areas are crossed by shallow, intermittent drainageways that are perpendicular to the streams. Slope ranges from 0 to 6 percent.

This association makes up about 10 percent of the county. It is about 29 percent Straw and similar soils, 29

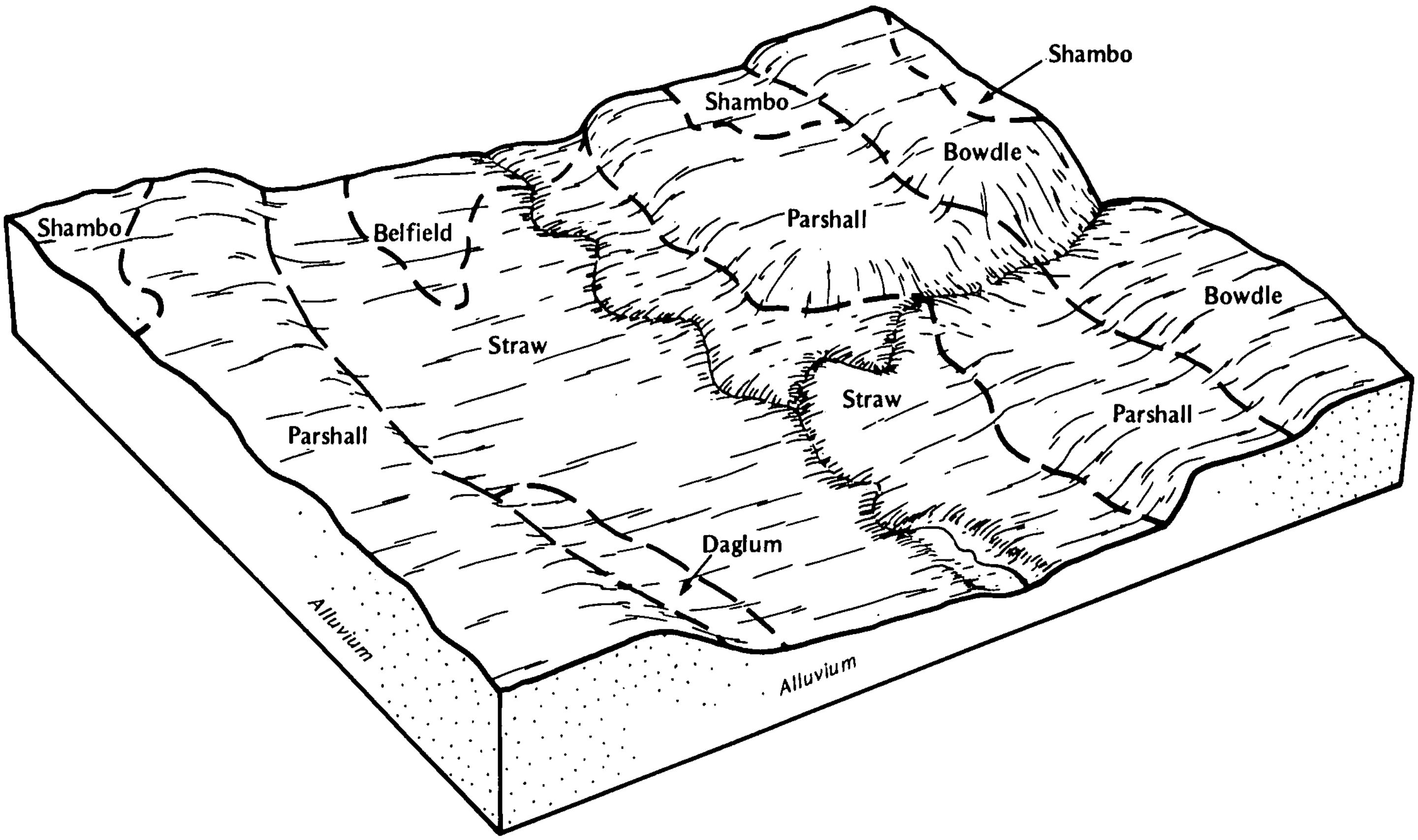


Figure 6.—Typical pattern of soils and underlying material in the Straw-Parshall-Bowdle association.

percent Parshall and similar soils, 15 percent Bowdle and similar soils, and 27 percent minor soils (fig. 6).

The level and nearly level Straw soils are on flood plains. Typically, they are loam throughout.

The nearly level and gently sloping Parshall soils are on terraces. Typically, they are fine sandy loam throughout.

The level to gently sloping Bowdle soils are on terraces. Typically, they have a loam surface layer, a loam and gravelly sandy loam subsoil, and a substratum of very gravelly loamy sand and stratified sand and gravel.

The most extensive minor soils in this association are the nearly level and gently sloping Belfield, Daglum, and Shambo soils. Belfield and Daglum soils are in swales. They have a sodic subsoil. Shambo soils are on flats on terraces. They have a loam surface layer and a sandy clay loam and fine sandy loam subsoil.

This association is used mainly for cultivated crops, hay, or pasture. It is suited to these uses and to range. Most areas have a sparse to dense stand of native trees and shrubs along the stream channels. These trees and shrubs provide food and cover for wildlife. The hazards of soil blowing and water erosion are the main concerns in managing cultivated areas. Other management concerns are flooding on the Straw soils, a restricted rooting depth caused by the sand and gravel in the Bowdle soils, and a moderate available water capacity in the Bowdle and Parshall soils.

The Parshall and Bowdle soils are suited to building site development, but the Straw soils are unsuited because of the flooding. The Parshall soils are suited to septic tank absorption fields, but the Straw soils are generally unsuited because of the flooding. The Bowdle soils are best suited to a mound type of absorption field.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Shambo loam, 1 to 3 percent slopes, is a phase in the Shambo series.

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

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Dumps-Pits complex 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.

Soil Descriptions

2—Heil silt loam. This deep, level, poorly drained, alkali soil is in basins and depressions on uplands and terraces. It is ponded following snowmelt and heavy rains. Slopes are concave, short, and smooth. Individual areas range from about 5 to 200 acres.

Typically, the surface layer is gray, mottled silt loam about 4 inches thick. The subsoil is silty clay about 32 inches thick. It is gray in the upper part, dark gray in the next part, and grayish brown in the lower part. The substratum to a depth of about 60 inches is olive gray silty clay. In places the surface layer is more than 4 inches thick. In cultivated areas it is silty clay or silty clay loam. In some areas the soil is not so dark and is calcareous throughout.

Included with this soil in mapping are small areas of the very poorly drained Dimmick soils in the deepest part of the depressions. These soils make up 5 to 15 percent of the unit.

Permeability is very slow in the Heil soil. Available water capacity and organic matter content are moderate. Runoff is ponded. A seasonal high water table is 1 foot above to 1 foot below the surface. The rooting depth is restricted by the dense, alkali subsoil.

Most areas are used as range. Some are used for cultivated crops or native hay. Because of the ponding, the salts, and the dense, alkali subsoil, this soil is generally unsuited to cultivated crops, trees, and shrubs. It is best suited to range. The key native plant is western wheatgrass. Altari wildrye, Russian wildrye, tall wheatgrass, western wheatgrass, and sweetclover are suitable pasture plants. Compaction, trampling, and root damage are problems, especially if the pasture or range is grazed during wet periods. They can be prevented by deferring grazing when the soil is wet. Potential water reservoir sites are available in most areas.

This soil generally is unsuited to dwellings and septic tank absorption fields because of the ponding, the very slow permeability, and the shrink-swell potential. Soils that are better suited to these uses generally are nearby.

The land capability classification is VIs. The productivity index for spring wheat is 0. The range site is Closed Depression.

3—Dimmick silty clay. This deep, level, very poorly drained soil is in basins on uplands. It is ponded during much of the growing season unless the amount of precipitation is low. Slopes are concave, short, and smooth. Individual areas range from about 5 to 100 acres.

Typically, the surface soil is mottled silty clay about 22 inches thick. It is gray in the upper part and dark gray in the lower part. The substratum to a depth of about 60 inches is mottled. It is gray silty clay in the upper part and olive gray clay in the lower part. In places the surface soil and substratum are silty clay loam or clay loam. In a few places the surface layer is light colored and calcareous throughout.

Included with this soil in mapping are small areas of the poorly drained Heil soils. These soils have a dense subsoil. They are on the shallow margin of basins. Also included are some areas that are subject to stream overflow. Included soils make up 10 to 15 percent of the unit.

Permeability is very slow in the Dimmick soil. Available water capacity and organic matter content are high. Runoff is ponded. A seasonal high water table is 1 foot above to 2 feet below the surface. Tilth is poor.

Most areas are used as range or native hayland. Some are drained and are used for cultivated crops. This soil is best suited to wetland wildlife habitat, range, and native hayland. In undrained areas the soil and the ponded water provide feeding, breeding, and rearing areas for wetland wildlife. The main concern in managing habitat for wetland wildlife is maintaining the natural water level. The soil generally is unsuited to small grain, trees and shrubs, and legumes unless it is drained. Outlets for drainage are difficult to locate. The major concerns in managing the soil for cultivated crops are wetness and soil blowing. A system of conservation tillage that leaves crop residue on the surface helps to control soil blowing. It also helps to provide food and nesting cover for resident and migratory wildlife.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas, however, generally are unsuited. The wetness is a critical limitation affecting survival, growth, and vigor. The cover of grasses and weeds that grows on this soil is abundant and persistent. Removing this cover before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in protecting this soil. The key range plants are rivergrass, slough sedge, and prairie cordgrass. Compaction, trampling, and root damage are problems, especially if the range is grazed during wet periods. They can be prevented by deferring grazing when the soil is wet. Potential water reservoir sites are available in most areas.

This soil generally is unsuited to dwellings and septic tank absorption fields because of the ponding, the very slow permeability, and the shrink-swell potential. Soils that are better suited to these uses generally are nearby.

The land capability classification is IIIw. The productivity index for spring wheat is 35 to 70, depending on the degree of drainage. The range site is Wetland.

4—Grail clay loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is in swales on uplands and terraces. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes generally are concave, long, and smooth. Individual areas range from about 5 to 100 acres.

Typically, the surface layer is very dark grayish brown clay loam about 9 inches thick. The subsoil is about 27 inches thick. In sequence downward, it is very dark grayish brown clay, dark grayish brown clay, grayish brown clay loam, and light brownish gray clay loam. The substratum to a depth of about 60 inches is grayish brown. It is sandy clay loam in the upper part and silty clay loam in the lower part. In places the surface layer is silty clay loam or silt loam. In a few places it is light colored. In some areas the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Daglum and Rhoades soils. These soils are in microdepressions. They have a dense, alkali subsoil. Also included are a few areas of the gently sloping Grail soils. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Grail soil. Available water capacity and organic matter content are high. Runoff is slow. The soil receives runoff from adjacent areas. Tilth is fair. Because of the high clay content, the surface layer is best tilled when the soil is neither too wet nor too dry. It tends to form clods when dry and puddle when wet.

Most areas are used for cultivated crops. Some are used as range or hayland. This soil is well suited to small grain and to grasses and legumes. The main management concerns are controlling water erosion in drainageways and maintaining tilth and fertility. Applying a system of conservation tillage that leaves crop residue on the surface and establishing grassed waterways in areas where runoff concentrates help to control water erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife. Conservation tillage and cover crops help to maintain fertility, increase the rate of water infiltration, and maintain the organic matter content.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect survival or growth. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are big bluestem, western wheatgrass, and green needlegrass. Crested wheatgrass, smooth bromegrass, big bluestem, switchgrass, alfalfa, and sweetclover are suitable pasture and hay plants. No major hazards or limitations affect the use of this soil for range or hay. Grazing management that maintains an adequate cover of the key plants helps to protect the soil. Potential water reservoir sites are available in most areas.

This soil is suited to dwellings and septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The slow absorption of liquid waste is a limitation in septic tank absorption fields, but it can be overcome by enlarging the absorption field.

The land capability classification is IIc. The productivity index for spring wheat is 89. The range site is Overflow.

5C—Wayden silty clay, 2 to 9 percent slopes. This shallow, nearly level to moderately sloping, well drained soil is on upland knobs and ridges. Some areas are crossed by shallow drainageways. Slopes generally are convex, short, and smooth. Individual areas range from about 5 to 75 acres.

Typically, the surface layer is grayish brown silty clay about 4 inches thick. The next layer is light brownish gray silty clay about 5 inches thick. The substratum is pale yellow silty clay about 9 inches thick. Shale bedrock is at a depth of about 18 inches. In some places the surface layer and substratum are silty clay loam or clay loam. In other places shale is within a depth of 10 inches.

Included with this soil in mapping are small areas of Amor, Moreau, Regent, and Rhoades soils. Amor, Moreau, and Regent soils have soft bedrock at a depth of 20 to 40 inches. They are on side slopes. Amor soils have a surface layer of loam, Moreau soils have one of silty clay, and Regent soils have one of silty clay loam. Rhoades soils are deep and have a dense, alkali subsoil. They are on foot slopes. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Wayden soil. Available water capacity and organic matter content are low. Runoff is rapid. The rooting depth is restricted by the shale at a depth of about 18 inches.

Most areas are used for cultivated crops. Some are used as native hayland or range. Because of the shallow rooting depth, the low available water capacity, a severe hazard of water erosion, and a moderate hazard of soil blowing, this soil is generally unsuited to small grain, trees and shrubs, and legumes. It is best suited to range. A cover of range plants is effective in controlling erosion. The key range plants are green needlegrass and western wheatgrass. Soil blowing, water erosion, and the low available water capacity are problems, especially if the range is overgrazed. Vegetation is difficult to reestablish in denuded areas. Grazing management that maintains an adequate cover of the key plants at a height that traps snow helps to store moisture, control soil blowing and water erosion, and prevent denuding. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. A high shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. A mound system helps to overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification is VIe. The productivity index for spring wheat is 0. The range site is Shallow Clay.

6B—Vebar-Parshall fine sandy loams, 1 to 6 percent slopes. These nearly level and gently sloping, well drained soils are on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. The moderately deep Vebar soil has convex, short, smooth slopes. It is on side slopes. The deep Parshall soil has concave, short, smooth slopes. It is in swales, on side slopes, and on foot slopes. Individual areas range from about 10 to 120 acres. They are about 35 to 55 percent Vebar soil and 30 to 50 percent Parshall soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Vebar soil has a surface layer of grayish brown fine sandy loam about 8 inches thick. The subsoil is about 26 inches thick. It is brown fine sandy loam in the upper part, pale brown fine sandy loam in the next part, and light gray loamy fine sand in the lower part. Light gray, soft sandstone bedrock is at a depth of about 34 inches. In places the surface layer is lighter colored. In a few places the soil is calcareous throughout. In some areas the depth to sandstone is more than 40 inches. In a few areas the surface layer and subsoil are loam.

Typically, the Parshall soil has a surface soil of dark grayish brown fine sandy loam about 10 inches thick. The subsoil is fine sandy loam about 25 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown fine sandy loam. In some places the surface layer is loam or sandy loam. In other places the substratum is gravelly loam below a depth of 35 inches. In a few areas the surface layer and subsoil are loam or loamy fine sand.

Included with these soils in mapping are small areas of Arnegard soils in swales and Flasher soils on knobs. Arnegard soils are deep, are dark to a depth of 16 inches or more, and are loam throughout. Flasher soils have a thin, light colored surface layer and have soft sandstone at a depth of 10 to 20 inches. Also included are a few areas of soils underlain by hard sandstone. Included soils make up 5 to 20 percent of the unit.

Permeability is moderately rapid in the Vebar and Parshall soils. Runoff is slow. Available water capacity is low in the Vebar soil and moderate in the Parshall soil. Organic matter content is moderately low in the Vebar soil and high in the Parshall soil. The rooting depth is restricted by the sandstone at a depth of about 34 inches in the Vebar soil. Tilth is good in both soils. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. A few are used as range or hayland. These soils are suited to small grain, legumes, and tame grasses. The major management concerns are soil blowing, the low available water capacity, and water erosion in drainageways. A system of conservation tillage that leaves crop residue on the surface, stripcropping, windbreaks, and grassed waterways in areas where runoff concentrates help to control soil blowing and water erosion. Conservation tillage also helps to provide food and nesting cover for resident and migratory wildlife. Conservation tillage and cover crops help to maintain or increase the organic matter content, reduce the runoff rate, and improve water infiltration.

The Parshall soil is suited to all and the Vebar soil to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings (fig. 7). The Vebar soil is somewhat droughty, and moisture stress is common, particularly during periods when the trees and shrubs are becoming established. Irrigation during these periods helps to ensure survival of the seedlings. Little benefit is derived from fallowing the Vebar soil during the season prior to planting because of the limited available water capacity. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are needleandthread and prairie sandreed. Crested wheatgrass, smooth bromegrass, intermediate wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Soil blowing and the low or moderate available water capacity are problems, especially if the range or pasture is overgrazed.

These soils are suited to dwellings. The Parshall soil is well suited to septic tank absorption fields, but the Vebar soil is poorly suited. The depth to bedrock in the Vebar soil is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored. The effluent from septic tank systems in the Vebar soil can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. Absorption fields should be installed on the Parshall soil. Otherwise, a mound system or alternative disposal systems should be considered.

The land capability classification is IIIe. The productivity index for spring wheat is 58. The range site is Sandy.

7C—Vebar-Flasher fine sandy loams, 3 to 9 percent slopes. These gently sloping and moderately sloping soils are on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. The well drained, moderately deep Vebar soil generally has convex, moderately long, smooth slopes. It is on side slopes. The shallow, somewhat excessively drained Flasher soil has convex, short, smooth slopes. It is on knobs and ridges. Individual areas range from about 10 to 200 acres. They are about 45 to 65 percent Vebar soil and 25 to 35 percent Flasher soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Vebar soil has a surface layer of grayish brown fine sandy loam about 8 inches thick. The subsoil is about 26 inches thick. It is brown fine sandy loam in the upper part, pale brown fine sandy loam in the next part, and light gray, calcareous loamy fine sand in the lower part. Light gray, soft sandstone bedrock is at a depth of about 34 inches. In some areas the surface layer is lighter colored and is calcareous. In a few places the depth to sandstone is more than 40 inches. In other places the surface layer and subsoil are loam.

Figure 7.—Vegetative barriers in an area of Vebar-Parshall fine sandy loams, 1 to 6 percent slopes.

Typically, the Flasher soil has a surface layer of grayish brown fine sandy loam about 6 inches thick. The substratum is very pale brown loamy fine sand about 11 inches thick. Light gray, soft sandstone bedrock is at a depth of about 17 inches. In some places the surface layer has been removed by soil blowing. In other places it is loamy fine sand. In some areas the substratum is loam or fine sandy loam.

Included with these soils in mapping are small areas of Arnegard and Parshall soils in swales. These included soils are deep and are dark to a depth of more than 16 inches. Arnegard soils have a surface layer of loam, and Parshall soils have one of fine sandy loam. Also included are a few areas where sandstone crops out on the tops of knobs and ridges and a few areas of soils underlain by hard sandstone. Included areas make up 5 to 20 percent of the unit.

Permeability is moderately rapid in the Vebar soil and rapid in the Flasher soil. Available water capacity is low in the Vebar soil and very low in the Flasher soil. Organic matter content is low in the Flasher soil and moderately low in the Vebar soil. Runoff is slow on both soils. The rooting depth is restricted by the sandstone at a depth of about 34 inches in the Vebar soil and 17 inches in the Flasher soil. Tilth is good in both soils. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range or hayland. These soils are poorly suited to small grain because of severe hazards of soil blowing and water erosion and the low or very low available water capacity. The major management concerns are controlling erosion and conserving moisture. A system of conservation tillage that leaves crop residue on the surface, stripcropping, buffer strips, windbreaks, cover crops, and grassed waterways in areas where runoff concentrates help to control soil blowing and water erosion (fig. 8). Conservation tillage and grassed waterways also help to provide food and cover for resident and migratory wildlife. Conservation tillage and cover crops help to maintain or increase the organic matter content and improve water infiltration.

The Flasher soil is generally unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Vebar soil is suited to many of the climatically adapted species. It is somewhat droughty, and moisture stress is common, particularly during periods when the trees and shrubs are becoming established. Irrigation during these periods helps to ensure survival of the seedlings. Little benefit is derived from fallowing during the season prior to planting because of the limited available water capacity. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are needleandthread, western wheatgrass, little bluestem, and prairie sandreed. Crested wheatgrass, intermediate wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Soil blowing and the low or very low available water capacity are problems, especially if the pasture or range is overgrazed. Vegetation is difficult to reestablish in denuded areas. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing and prevents denuding.

Figure 8.—Stripcropping and field windbreaks in an area of Vebar-Flasher fine sandy loams, 3 to 9 percent slopes.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. In areas of the Vebar soil, the sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored. The effluent from septic tank systems can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. Absorption fields should be installed on the Vebar soil. Otherwise, a mound system or alternative sites or disposal systems should be considered.

The land capability classification assigned to the Vebar soil is IVe, and that assigned to the Flasher soil is VIe. The productivity index for spring wheat is 50. The Vebar soil is assigned to the Sandy range site and the Flasher soil to the Shallow range site.

8—Belfield-Savage-Daglum silt loams, 1 to 3 percent slopes. These nearly level, deep soils are on flats in the uplands. Most areas are crossed by shallow drainageways. In cultivated areas slopes generally are concave, moderately long, and smooth. In areas of native grass, they are moderately long and smooth. The surface has a characteristic microrelief. Generally, the well drained, alkali Belfield soil and the well drained, nonalkali Savage soil are on small mounds, and the well drained and moderately well drained, alkali Daglum soil is in microdepressions. Individual areas range from about 10 to 300 acres. They are about 30 to 45 percent Belfield soil, 30 to 45 percent Savage soil, and 10 to 40 percent Daglum soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Belfield soil has a surface layer of grayish brown silt loam about 9 inches thick. The next 3 inches is grayish brown silty clay loam that has light gray coatings. The subsoil is about 21 inches thick. The upper part is grayish brown silty clay, and the lower part is light brownish gray silty clay loam. The substratum to a depth of about 60 inches is grayish brown and light brownish gray silty clay loam. In some places the surface layer is loam, clay loam, or silty clay loam. In other places the substratum is stratified with loam or sandy loam.

Typically, the Savage soil has a surface layer of dark grayish brown silt loam about 6 inches thick. The subsoil is about 30 inches thick. It is dark grayish brown clay in the upper part, grayish brown clay in the next part, and light yellowish brown clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray and light yellowish brown clay loam. In places the surface layer is clay loam.

Typically, the Daglum soil has a surface layer of dark grayish brown silt loam about 7 inches thick. The subsurface layer is grayish brown silt loam about 1 inch thick. The subsoil is about 24 inches thick. It is dark grayish brown clay in the upper part and grayish brown clay loam in the lower part. The upper part of the substratum is grayish brown clay loam. The lower part to a depth of about 60 inches is light yellowish brown clay. In some places the surface layer is loam, clay loam, or silty clay loam. In other places, the surface layer is lighter colored and the subsoil has been mixed with the surface layer by cultivation. In a few areas the substratum is stratified with loam or fine sandy loam.

Included with these soils in mapping are small areas of Grail, Rhoades, and Shambo soils. Grail soils are dark to a depth of more than 16 inches. They are in swales. Rhoades soils have a dense, alkali subsoil at a depth of about 5 inches. They are in swales. Shambo soils are loam throughout. They are on small mounds. Also included are some areas of Belfield soils, which are subject to flooding, and a few small areas where shale bedrock is at a depth of 36 to 50 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Belfield and Savage soils and very slow in the Daglum soil. Available water capacity is high in the Belfield and Savage soils and moderate in the Daglum soil. Organic matter content is moderate in all three soils. Runoff is slow. The rooting depth is restricted by the dense, alkali subsoil in the Belfield and Daglum soils. Tilth is good. The surface layer is friable and generally can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. These soils are suited to small grain, grasses, and legumes. The major management concerns are water erosion in drainageways and droughtiness. During dry periods small grain and other crops vary in height because of moisture-stress differences among the three soils. A system of conservation tillage that leaves crop residue on the surface, grassed waterways in areas where runoff concentrates, and a cropping sequence that includes grasses and legumes help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Including deep rooted plants, such as legumes, in the crop rotation helps to loosen the dense subsoil. Cover crops, conservation tillage, and a cover of grasses and legumes help to maintain or increase the organic matter content and improve water infiltration.

The Daglum soil is suited to only a few of the drought- and salt-tolerant trees and shrubs grown as windbreaks and environmental plantings. The Savage soil is suited to nearly all and the Belfield soil to many of the climatically adapted species. Removing weeds and grasses before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. The trees and shrubs vary in height, density, and vigor because in the Daglum and Belfield soils root development is restricted by the dense subsoil and available water capacity is reduced by the salts.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass, needleandthread, blue grama, and green needlegrass. Crested wheatgrass, smooth bromegrass, intermediate wheatgrass, hard fescue, alfalfa, and sweetclover are suitable pasture and hay plants. No major hazards or limitations affect the use of these soils for range or pasture. Grazing management that maintains an adequate cover of the key plants helps to protect the soils.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. A high shrink-swell potential is a limitation on sites for buildings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The Belfield and Savage soils are better suited to conventional septic tank absorption fields than the Daglum soil. The slow absorption of liquid waste is a limitation, but it can be overcome by enlarging the absorption field. A mound system is needed in areas of the Daglum soil.

The land capability classification assigned to the Belfield soil is IIIs, that assigned to the Savage soil is IIs, and that assigned to the Daglum soil is IVs. The productivity index for spring wheat is 68. The Belfield and Savage soils are assigned to the Clayey range site and the Daglum soil to the Claypan range site.

8B—Belfield-Savage-Daglum silt loams, 3 to 6 percent slopes. These gently sloping, deep soils are on uplands. Most areas are crossed by shallow drainageways. In cultivated areas slopes generally are convex, long, and smooth. In areas of native grass, they are long and smooth. The surface has a characteristic microrelief. The well drained, alkali Belfield soil and the well drained, nonalkali Savage soil are on small mounds, and the well drained and moderately well drained, alkali Daglum soil is in microdepressions. Individual areas range from about 10 to 400 acres. They are about 25 to 50 percent Belfield soil, 25 to 50 percent Savage soil, and 15 to 35 percent Daglum soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Belfield soil has a surface layer of grayish brown silt loam about 9 inches thick. The next layer is grayish brown silty clay loam about 3 inches thick. It has light gray coatings. The subsoil is about 21 inches thick. The upper part is grayish brown silty clay, and the lower part is light brownish gray silty clay loam. The substratum to a depth of about 60 inches is grayish brown and light brownish gray silty clay loam. In some areas the surface layer is loam, clay loam, or silty clay loam. In a few places the substratum is stratified with loam or sandy loam.

Typically, the Savage soil has a surface layer of dark grayish brown silt loam about 6 inches thick. The subsoil is about 30 inches thick. It is dark grayish brown clay in the upper part, grayish brown clay in the next part, and light yellowish brown clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray and light yellowish brown clay loam. In places the surface layer is clay loam.

Typically, the Daglum soil has a surface layer of dark grayish brown silt loam about 7 inches thick. The subsurface layer is grayish brown silt loam about 1 inch thick. The subsoil is about 24 inches thick. It is dark grayish brown clay in the upper part and grayish brown clay loam in the lower part. The upper part of the substratum is grayish brown clay loam. The lower part to a depth of about 60 inches is light yellowish brown clay. In some places the surface layer is fine sandy loam, loam, clay loam, or silty clay loam. In other places it is lighter colored and has been mixed with the subsoil by cultivation. In a few areas the substratum is loam or fine sandy loam.

Included with these soils in mapping are small areas of Amor, Regent, Parshall, Rhoades, Shambo, and Vebar soils. Amor, Regent, and Vebar soils are moderately deep and are on side slopes. Amor soils have a surface layer of loam, Regent soils have one of silty clay loam, and Vebar soils have one of fine sandy loam. Parshall, Rhoades, and Shambo soils are deep and are on foot slopes. Parshall soils have a subsoil of fine sandy loam, Rhoades soils have one of silty clay, and Shambo soils have one of loam. Also included are some gently rolling areas and a few areas where shale bedrock is at a depth of 36 to 50 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Belfield and Savage soils and very slow in the Daglum soil. Available water capacity is high in the Belfield and Savage soils and moderate in the Daglum soil. Organic matter content is moderate in all three soils. Runoff is slow. The rooting depth is restricted by the dense, alkali (sodic) subsoil of the Belfield and Daglum soils. Tilth is good in all three soils. The surface layer is friable and generally can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. These soils are suited to small grain, tame grasses, and legumes. The major management concerns are water erosion and droughtiness. During dry periods small grain and other crops vary in height because of moisture-stress differences among the three soils. Grassed waterways in areas where runoff concentrates, a system of conservation tillage that leaves crop residue on the surface, and a cropping sequence that includes grasses and legumes help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Including deep rooted plants, such as legumes, in the crop rotation helps to loosen the dense subsoil. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain or increase the organic matter content and improve water infiltration.

The Daglum soil is suited to only a few of the drought- and salt-tolerant trees and shrubs grown as windbreaks and environmental plantings. The Savage soil is suited to nearly all and the Belfield soil to many of the climatically adapted species. Removing weeds and grasses before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. The trees and shrubs vary in height, density, and vigor because in the Daglum and Belfield soils root development is restricted by the dense subsoil and the available water capacity is reduced by the salts.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass, needleandthread, blue grama, and green needlegrass. Crested wheatgrass, smooth bromegrass, intermediate wheatgrass, hard fescue, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem, especially if the range or pasture is overgrazed. Grazing management that maintains an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fencing and a planned grazing system help to control the pattern of livestock traffic and thus help to prevent gullying and improve gullied areas.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. A high shrink-swell potential is a limitation on sites for buildings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The Belfield and Savage soils are better suited to conventional septic tank absorption fields than the Daglum soil. The slow absorption of liquid waste is a limitation, but it can be overcome by enlarging the absorption field. A mound system is needed in areas of the Daglum soil.

The land capability classification assigned to the Belfield soil is IIIe, that assigned to the Savage soil is IIe, and that assigned to the Daglum soil is IVs. The productivity index for spring wheat is 61. The Belfield and Savage soils are assigned to the Clayey range site and the Daglum soil to the Claypan range site.

9B—Regent silty clay loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes are convex, moderately long, and smooth. Individual areas range from about 10 to 350 acres.

Typically, the surface layer is dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 29 inches thick. It is brown silty clay in the upper part, grayish brown silty clay loam in the next part, and light brownish gray silty clay loam in the lower part. Olive, soft shale bedrock is at a depth of about 36 inches. In places the depth to shale bedrock is more than 40 inches. In a few places the surface layer is loam, silt loam, or clay loam. In some areas the subsoil is silt loam. In a few areas the surface layer is grayish brown.

Included with this soil in mapping are small areas of Amor, Chama, and Sen soils on side slopes, Cabba soils on convex knobs, and Daglum and Grail soils in swales. Amor soils have a loam subsoil, and Chama and Sen soils have one of silt loam. Cabba soils do not have a dark surface layer and have soft bedrock at a depth of 10 to 20 inches. Daglum and Grail soils are deep. Daglum soils have a dense, alkali subsoil. Grail soils are dark to a depth of more than 16 inches. Also included are some small nearly level and moderately sloping areas. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Regent soil. Available water capacity and organic matter content are moderate. Runoff is slow. The rooting depth is restricted by the shale bedrock at a depth of about 36 inches. Tilth is fair. Because of the high clay content, the surface layer is best tilled when the soil is neither too wet nor too dry. It tends to form clods when dry and puddle when wet.

Most areas are used for cultivated crops. A few are used as range. This soil is well suited to small grain and to grasses and legumes. Water erosion is the main management concern. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, by stripcropping, and by grassed waterways in areas where runoff concentrates. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage and cover crops help to maintain the organic matter content, reduce the runoff rate, and improve water infiltration.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing weeds and grasses before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and green needlegrass. Crested wheatgrass, smooth bromegrass, western wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem, especially if the range or pasture is overgrazed. Grazing management that maintains an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. A high shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. A mound system helps to overcome the depth to bedrock and a slow absorption rate. If these limitations cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification is IIe. The productivity index for spring wheat is 72. The range site is Clayey.

9C—Regent-Cabba complex, 6 to 9 percent slopes. These moderately sloping, well drained soils are on uplands. Most areas are crossed by shallow drainageways. The moderately deep Regent soil has convex, long, smooth slopes. It is on side slopes. The shallow Cabba soil has convex, short, smooth slopes. It is on the upper side slopes, knobs, and ridges. Individual areas range from about 5 to 200 acres. They are about 55 to 70 percent Regent soil and 20 to 35 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Regent soil has a surface layer of dark grayish brown silty clay loam about 5 inches thick. The subsoil is grayish brown silty clay loam about 8 inches thick. The substratum is silty clay loam about 12 inches thick. It is light brownish gray in the upper part and light yellowish brown in the lower part. Grayish brown and light yellowish brown, soft shale bedrock is at a depth of about 25 inches. In places the surface layer and subsoil are silty clay. In a few areas soft bedrock is at a depth of more than 40 inches.

Typically, the Cabba soil has a surface layer of light brownish gray silt loam about 4 inches thick. The subsoil is light yellowish brown loam about 9 inches thick. The substratum is silt loam about 4 inches thick. It is pale yellow in the upper part and light brownish gray in the lower part. Grayish brown and light yellowish brown, soft bedrock is at a depth of about 17 inches. In places the surface layer and substratum are silty clay loam or silty clay. In a few areas the surface layer is dark grayish brown.

Included with these soils in mapping are small areas of Amor soils on side slopes and Daglum, Grail, and Lawther soils in swales. Amor soils are loam throughout. Daglum soils are deep and have a dense, alkali subsoil. Grail and Lawther soils are deep. They are dark to a depth of more than 16 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Regent soil and moderate in the Cabba soil. Available water capacity and organic matter content are moderate in the Regent soil and very low in the Cabba soil. Runoff is medium on both soils. The rooting depth is restricted by the bedrock at a depth of about 25 inches in the Regent soil and 17 inches in the Cabba soil. Tilth is fair in both soils. Because of the high clay content, the surface layer of the Regent soil is best tilled when the soil is neither too wet nor too dry. It tends to form clods when dry and puddle when wet. The Cabba soil has a friable surface layer that can be easily tilled.

Most areas are used for cultivated crops. A few are used as range. These soils are suited to small grain and to grasses and legumes. The major management concerns are water erosion and soil blowing and the droughtiness of the Cabba soil. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, windbreaks, and grassed waterways in areas where runoff concentrates help to control water erosion and soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Cover crops and conservation tillage help to maintain the organic matter content, reduce the runoff rate, and improve water infiltration.

The Cabba soil is generally unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Regent soil is suited to many of the climatically adapted species. Removing weeds and grasses before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass, green needlegrass, needleandthread, and little bluestem. Crested wheatgrass, smooth bromegrass, western wheatgrass, sweetclover, and alfalfa are suitable pasture and hay plants. Water erosion is a problem, especially if the pasture or range is overgrazed. Grazing management that maintains an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. A high or moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The effluent from septic tank systems can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. Absorption fields should be installed on the Regent soil. A mound system helps to overcome the depth to bedrock and a slow absorption rate. If these limitations cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification assigned to the Regent soil is IIIe, and that assigned to the Cabba soil is VIe. The productivity index for spring wheat is 51. The Regent soil is assigned to the Clayey range site and the Cabba soil to the Shallow range site.

10B—Beisigl-Lihen loamy fine sands, 1 to 6 percent slopes. These nearly level and gently sloping soils are on uplands. Most areas are crossed by shallow drainageways. The moderately deep, somewhat excessively drained Beisigl soil has convex, short, smooth slopes. It is on the upper side slopes, on the summits of low rises, and on knobs. The deep, well drained Lihen soil has concave, short, smooth slopes. It is on the lower side slopes and in swales. Individual areas range from about 10 to 150 acres. They are about 50 to 60 percent Beisigl soil and 30 to 50 percent Lihen soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Beisigl soil has a surface layer of grayish brown loamy fine sand about 5 inches thick. The subsoil is loamy fine sand about 22 inches thick. It is light yellowish brown in the upper part and pale yellow in the lower part. Pale yellow, soft sandstone bedrock is at a depth of about 27 inches. In places the depth to sandstone is more than 40 inches. In a few areas the surface layer is fine sandy loam, and in other areas it is dark grayish brown and is as much as 10 inches thick.

Typically, the Lihen soil has a surface soil of loamy fine sand about 18 inches thick. It is grayish brown in the upper part and brown in the lower part. The subsoil is about 27 inches thick. It is brown loamy fine sand in the upper part and light olive brown fine sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand. In places the soil is not dark to so great a depth.

Included with these soils in mapping are small areas of Flasher soils on knobs and Vebar soils on side slopes. Flasher soils have soft sandstone at a depth of 10 to 20 inches. Vebar soils are fine sandy loam throughout. Included soils make up 5 to 20 percent of the unit.

Permeability is rapid in the Beisigl and Lihen soils. Available water capacity is very low in the Beisigl soil and low in the Lihen soil. Organic matter content is low in the Beisigl soil and moderately low in the Lihen soil. Runoff is slow on both soils. The rooting depth is restricted by the sandstone bedrock at a depth of about 27 inches in the Beisigl soil. Tilth is good in both soils. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used as range. Some are used for cultivated crops, hay, or pasture. These soils are poorly suited to small grain because of droughtiness and a severe hazard of soil blowing. The main management concerns are controlling soil blowing and conserving moisture. Several conservation practices generally are needed to control soil blowing if cultivated crops are grown. These practices include a system of conservation tillage that leaves crop residue on the surface, buffer strips, cover crops, stripcropping, and a cropping sequence that includes grasses and legumes. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain the organic matter content, increase the moisture supply by trapping snow, and improve water infiltration.

The Beisigl soil is suited to a few and the Lihen soil to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The soils are somewhat droughty, and moisture stress is common, particularly during periods when the trees and shrubs are becoming established. Irrigation during these periods helps to ensure survival of the seedlings. Little benefit is derived from fallowing during the season prior to planting because of the limited available water capacity. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are needleandthread and prairie sandreed. Intermediate wheatgrass, prairie sandreed, slender wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Soil blowing and the very low or low available water capacity are problems, especially if the pasture or range is overgrazed. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing and prevents denuding.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. The depth to bedrock in the Beisigl soil is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored. The Lihen soil is better suited to absorption fields than the Beisigl soil. Both soils readily absorb but do not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The effluent in the Beisigl soil can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. A mound system helps to overcome the depth to bedrock and the poor filtering capacity.

The land capability classification is IVe. The productivity index for spring wheat is 35. The range site is Sands.

10D—Beisigl-Flasher loamy fine sands, 6 to 20 percent slopes. These moderately sloping to moderately steep, somewhat excessively drained soils are on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. The moderately deep Beisigl soil has convex, moderately long, smooth slopes. It is on side slopes. The shallow Flasher soil has convex, short, uneven slopes. It is on knobs and ridges. Individual areas range from about 10 to 250 acres in size. They are about 50 to 60 percent Beisigl soil and 25 to 35 percent Flasher soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Beisigl soil has a surface layer of grayish brown loamy fine sand about 5 inches thick. The subsoil is loamy fine sand about 22 inches thick. It is light yellowish brown in the upper part and pale yellow in the lower part. Pale yellow, soft sandstone bedrock is at a depth of about 27 inches. In some places the surface layer is not calcareous, is fine sandy loam, or is dark to a depth of more than 5 inches. In other places the depth to soft sandstone is more than 40 inches.

Typically, the Flasher soil has a surface layer of grayish brown loamy fine sand about 3 inches thick. The next layer is light olive brown loamy fine sand about 7 inches thick. The substratum also is loamy fine sand about 7 inches thick. It is light olive brown in the upper part and grayish brown in the lower part. Light yellowish brown, soft sandstone bedrock is at a depth of about 17 inches. In some places the sandstone is hard. In other places the surface layer and substratum are fine sandy loam or loam. In a few areas the surface layer is stony.

Included with these soils in mapping are small areas of Arnegard, Lihen, and Parshall soils in swales and Regan soils in drainageways. Arnegard, Lihen, and Parshall soils are deep and are dark to a depth of more than 16 inches. Regan soils are poorly drained. They have a layer of accumulated lime within a depth of 16 inches. Also included are some areas where sandstone crops out. Included areas make up 5 to 20 percent of the unit.

Permeability is rapid in the Beisigl and Flasher soils. Available water capacity is very low. Organic matter content is moderately low in the Beisigl soil and low in the Flasher soil. Runoff is medium on both soils. The rooting depth is restricted by the sandstone at a depth of about 27 inches in the Beisigl soil and at 17 inches in the Flasher soil.

Most areas are used as range. Some are used for hay, pasture, or cultivated crops. Because of a severe hazard of soil blowing, droughtiness, the slope, and the shallow rooting depth in the Flasher soil, these soils are generally unsuited to trees and shrubs and to small grain. They are best suited to range. A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are needleandthread, little bluestem, western wheatgrass, and prairie sandreed. Crested wheatgrass, meadow bromegrass, prairie sandreed, sweetclover, and alfalfa are suitable hay and pasture plants. Soil blowing and the very low available water capacity are problems, especially if the pasture or range is overgrazed. Vegetation is difficult to reestablish in denuded areas. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing and prevents denuding.

These soils are poorly suited to dwellings and septic tank absorption fields. The depth to rock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The slope is a limitation on sites for dwellings and absorption fields, but it can be overcome by designing the dwellings and absorption fields so that they conform to the natural slope of the land. In areas of the Beisigl soil, the sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored. Absorption fields should be installed on the Beisigl soil. The effluent from septic tank systems can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. A mound system helps to overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification is VIe. The productivity index for spring wheat is 0. The Beisigl soil is assigned to the Sands range site and the Flasher soil to the Shallow range site.

11B—Moreau silty clay, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes are convex and moderately long. They generally are smooth. In some areas of range, however, they are uneven. Individual areas range from about 10 to 100 acres.

Typically, the surface layer is grayish brown silty clay about 4 inches thick. The subsoil is silty clay about 24 inches thick. It is light brownish gray in the upper part and light olive gray in the lower part. The substratum is light olive gray silty clay about 6 inches thick. Light gray and pale yellow, soft shale bedrock is at a depth of about 34 inches. In some places the surface layer is dark grayish brown. In other places the depth to shale is more than 40 inches. In some areas, the subsoil has accumulated clay and the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Amor soils on side slopes, Wayden soils on knobs, and Daglum and Lawther soils on the lower side slopes and in swales. Amor and Lawther soils have a dark surface layer that is thicker than that of the Moreau soils. Amor soils are loam throughout, and Lawther soils are deep. Wayden soils have shale bedrock at a depth of 10 to 20 inches. Daglum soils have a dense, alkali subsoil. Also included are some nearly level and moderately sloping areas. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Moreau soil. Available water capacity is moderate, and organic matter content is moderately low. Runoff is medium. The rooting depth is restricted by the shale bedrock at a depth of about 34 inches. Tilth is poor. Because of the high clay content, the surface layer is best tilled when the soil is neither too wet nor too dry. It tends to form clods when dry and puddle when wet.

Most areas are used for cultivated crops. Some are used for hay or pasture. This soil is suited to small grain and to grasses and legumes. The major management concerns are soil blowing, water erosion, tilth, and the moderate available water capacity. A system of conservation tillage that leaves crop residue on the surface, stripcropping, buffer strips, windbreaks, and grassed waterways in areas where runoff concentrates help to control soil blowing and water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage and cover crops help to maintain the organic matter content, maintain or improve tilth, reduce the runoff rate, and improve water infiltration.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing weeds and grasses before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. The trees and shrubs vary in height, density, and vigor because of the restricted root development in the dense subsoil and the reduced available water capacity caused by the salts in the soil. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and green needlegrass. Crested wheatgrass, hard fescue, green needlegrass, slender wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem, especially if the range or pasture is overgrazed. Grazing management that maintains an adequate cover of the key plants helps to prevent excessive soil loss. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. A high shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. A mound system helps to overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification is IIIe. The productivity index for spring wheat is 56. The range site is Clayey.

12B—Rhoades-Daglum silt loams, 1 to 6 percent slopes. These deep, alkali, nearly level and gently sloping, well drained and moderately well drained soils are in swales on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes generally are convex, long, and uneven. The surface has a characteristic microrelief of microdepressions, microhighs, and barren scab spots. The Rhoades soil is in the microdepressions, and the Daglum soil is on the microhighs. Individual areas range from about 10 to 350 acres. They are about 50 to 60 percent Rhoades soil and 25 to 45 percent Daglum soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Rhoades soil has a surface layer of light brownish gray silt loam about 3 inches thick. The subsoil is silty clay about 43 inches thick. It is dark grayish brown in the upper part, grayish brown in the next part, and light yellowish brown in the lower part. The substratum to a depth of about 60 inches is pale yellow, stratified silt loam and silty clay loam. In places the surface layer is fine sandy loam, loam, or silty clay loam.

Typically, the Daglum soil has a surface layer of dark grayish brown silt loam about 7 inches thick. The subsurface layer is grayish brown silt loam about 1 inch thick. The subsoil is about 24 inches thick. It is dark grayish brown clay in the upper part and grayish brown clay loam in the lower part. The upper part of the substratum is grayish brown clay loam. The lower part to a depth of about 60 inches is light yellowish brown clay. In places the surface layer is fine sandy loam, loam, or silty clay loam.

Included with these soils in mapping are small areas of Belfield, Ekalaka, and Savage soils in swales and Harriet soils in drainageways. Belfield soils do not have columnar structure in the upper part of the subsoil. Ekalaka soils are fine sandy loam throughout. Savage soils have a nonalkali subsoil. Harriet soils are poorly drained. Also included are some small areas that are subject to flooding, a few small areas where bedrock is at a depth of 40 to 60 inches, and a few stony areas. Included soils make up 5 to 20 percent of the unit.

Permeability is very slow in the Rhoades and Daglum soils. Available water capacity is moderate. Organic matter content is moderately low in the Rhoades soil and moderate in the Daglum soil. Runoff is medium on both soils. The rooting depth is restricted by the dense, alkali subsoil. If cultivated, the surface layer generally forms a crust following rainfall.

Some areas are used for cultivated crops. Some are used as range. Because of the dense subsoil, droughtiness, and soluble salts in the root zone, these soils are generally unsuited to small grain, legumes, and tame grasses. They are best suited to range. A cover of hay or of pasture or range plants is effective in protecting the soils. The key range plants are western wheatgrass and blue grama. The dense subsoil, which restricts root penetration, and the salts, which reduce the amount of water available to plants, are problems, especially if the range is overgrazed. Vegetation is difficult to reestablish in denuded areas. Grazing management that maintains an adequate cover of the key plants helps to protect the range. Potential pond reservoir sites generally are available in the drainageways that cross areas of this unit. The ponds constructed in these soils, however, sometimes contain salty water.

The Rhoades soil is generally unsuited to the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. The Daglum soil is suited to only a few of the drought- and salt-tolerant species. Irrigation and control of the ground cover help to ensure survival of the seedlings. The trees and shrubs vary in height, density, and vigor, however, because of the restricted root development in the dense subsoil and the reduced available water capacity caused by the salts in the soils.

These soils are suited to dwellings but are generally unsuited to septic tank absorption fields. A high shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing foundation and basement walls help to prevent the structural damage caused by shrinking and swelling. Alternative sites for septic tank absorption fields or alternative disposal systems, such as a mound system, should be considered because of the high clay content and the very slow permeability.

The land capability classification assigned to the Rhoades soil is VIs, and that assigned to the Daglum soil is IVs. The productivity index for spring wheat is 0. The Rhoades soil is assigned to the Thin Claypan range site and the Daglum soil to the Claypan range site.

13—Lawther silty clay, 1 to 3 percent slopes. This deep, nearly level, well drained soil is in swales on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes are concave, moderately long, and smooth. Individual areas range from about 10 to 100 acres.

Typically, the surface soil is dark grayish brown silty clay about 10 inches thick. The subsoil is silty clay about 37 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum to a depth of about 60 inches is grayish brown clay loam. In some places the surface layer is clay or silty clay loam. In other places it is calcareous.

Included with this soil in mapping are small areas of Moreau soils on knobs and Rhoades soils in drainageways. Moreau soils have a light colored surface layer and have soft shale at a depth of 20 to 40 inches. Rhoades soils have a thin surface layer of silt loam and a dense, alkali subsoil. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Lawther soil. Available water capacity is high, and organic matter content is moderate. Runoff is slow. The soil generally receives runoff from adjacent areas. Tilth is poor. Because of the high clay content, the surface layer is best tilled when the soil is neither too wet nor too dry. It tends to form clods when dry, puddle when wet, and break down to fine granules during periods of freezing and thawing.

Most areas are used for cultivated crops. Some are used as hayland, pasture, or range. This soil is well suited to small grain and to grasses and legumes. The main management concerns are maintaining good tilth and controlling soil blowing. A system of conservation tillage that leaves crop residue on the surface, stripcropping, buffer strips, windbreaks, and grassed waterways in areas where runoff concentrates help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage and cover crops help to maintain the organic matter content, maintain or improve tilth, reduce the runoff rate, and increase the rate of water infiltration.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing weeds and grasses before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and green needlegrass. Crested wheatgrass, hard fescue, green needlegrass, slender wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. No major hazards or limitations affect the use of this soil for range or pasture. Grazing management that maintains an adequate cover of the key plants helps to protect the soil.

This soil is suited to dwellings and septic tank absorption fields. A high shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The slow absorption of liquid waste is a limitation in septic tank absorption fields, but it can be overcome by enlarging the absorption field or by using a mound system.

The land capability classification is IIs. The productivity index for spring wheat is 83. The range site is Clayey.

14B—Parshall fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is in swales on uplands and on terraces. Most areas are crossed by shallow drainageways. Slopes generally are concave, moderately long, and smooth. Individual areas range from about 10 to 250 acres.

Typically, the surface soil is dark grayish brown fine sandy loam about 10 inches thick. The subsoil is fine sandy loam about 25 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown fine sandy loam. In some places the surface layer is loam or sandy loam. In other places the substratum is gravelly sandy loam below a depth of 35 inches. In a few areas the surface layer and subsoil are loam or loamy fine sand.

Included with this soil in mapping are small areas of Bowdle and Vebar soils. Bowdle soils have sand and gravel at a depth of 20 to 40 inches. They occur as areas intermingled with areas of the Parshall soil. Vebar soils have soft sandstone at a depth of 20 to 40 inches. They are on side slopes. Also included are some moderately sloping areas. Included soils make up 5 to 20 percent of the unit.

Permeability is moderately rapid in the Parshall soil. Available water capacity and organic matter content are moderate. Runoff is slow. The soil generally receives runoff from adjacent areas. Tilth is good. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops, hay, or pasture. A few are used as range. This soil is suited to small grain and to grasses and legumes. Soil blowing is the major management concern. It can be controlled by windbreaks, buffer strips, a system of conservation tillage that leaves crop residue on the surface, stripcropping, and a cropping sequence that includes grasses and legumes. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain the organic matter content and improve water infiltration.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect survival and growth. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are needleandthread and prairie sandreed. Crested wheatgrass, smooth bromegrass, prairie sandreed, slender wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Soil blowing and the moderate available water capacity are problems in overgrazed pastures. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing and prevents denuding.

This soil is suited to dwellings and septic tank absorption fields. The sides of shallow excavations, such as those for basements, tend to cave in unless they are shored.

The land capability classification is IIIe. The productivity index for spring wheat is 67. The range site is Sandy.

15—Arnegard loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is in swales on uplands and on terraces. Most areas are crossed by shallow drainageways, but in some areas drainageways fan out and are indistinct and in a few areas they are entrenched. Slopes generally are concave, moderately long, and smooth. Individual areas range from about 10 to 100 acres.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The subsoil is loam about 33 inches thick. It is dark grayish brown in the upper part, brown in the next part, and light brownish gray in the lower part. The substratum to a depth of about 60 inches is light yellowish brown fine sandy loam. In places the soil is dark to a depth of less than 16 inches. In a few places the surface layer is silt loam or fine sandy loam. In some areas the subsoil is clay loam or fine sandy loam.

Included with this soil in mapping are small areas of Amor, Belfield, Grail, and Vebar soils. Amor and Vebar soils are dark to a depth of less than 16 inches and have soft bedrock at a depth of 20 to 40 inches. They are on side slopes. Belfield and Grail soils have more clay in the subsoil than the Arnegard soil. Also included are a few small gently sloping areas. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Arnegard soil. Available water capacity and organic matter content are high. Runoff is slow. The soil generally receives runoff from adjacent areas. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops, hay, or pasture. Some are used as range. This soil is well suited to small grain and to grasses and legumes. The major management concerns are controlling water erosion in drainageways and maintaining tilth and fertility. Applying a system of conservation tillage that leaves crop residue on the surface and establishing grassed waterways in areas where runoff concentrates help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife and maintains tilth and fertility.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect survival or growth. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are big bluestem, western wheatgrass, and green needlegrass. Altari wildrye, Russian wildrye, smooth bromegrass, big bluestem, green needlegrass, alfalfa, and sweetclover are suitable pasture and hay plants. No major hazards or limitations affect the use of this soil for range or pasture. Grazing management that maintains an adequate cover of the key plants helps to protect the soil.

This soil is suited to dwellings and septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The slow absorption of liquid waste is a limitation in septic tank absorption fields, but it can be overcome by enlarging the absorption field. The sides of shallow excavations, such as those for basements, tend to cave in unless they are shored.

The land capability classification is IIc. The productivity index for spring wheat is 98. The range site is Overflow.

16—Shambo loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces and uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes are convex, long, and smooth. Individual areas range from about 10 to 400 acres.

Typically, the surface layer is loam about 9 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is about 32 inches thick. It is brown sandy clay loam in the upper part, grayish brown sandy clay loam in the next part, and grayish brown fine sandy loam in the lower part. The substratum to a depth of about 60 inches is grayish brown fine sandy loam. In places the soil is dark to a depth of more than 16 inches. In some areas the surface layer and the upper part of the subsoil are fine sandy loam. In a few places the surface layer is gravelly loam.

Included with this soil in mapping are small areas of Belfield and Grail soils in drainageways and Ruso soils on slight rises. Belfield and Grail soils have more clay in the subsoil than the Shambo soil. Ruso soils are fine sandy loam in the surface layer and the upper part of the subsoil and have sand and gravel at a depth of 20 to 40 inches. Also included are a few small gently sloping areas. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Shambo soil. Available water capacity is high, and organic matter content is moderate. Runoff is slow. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. This soil is well suited to small grain and to grasses and legumes. The major management concerns are controlling water erosion in drainageways and maintaining tilth and fertility. Applying a system of conservation tillage that leaves crop residue on the surface and establishing grassed waterways in areas where runoff concentrates help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife and maintains tilth and fertility.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and needleandthread. Crested wheatgrass, smooth bromegrass, green needlegrass, slender wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. No major hazards or limitations affect the use of this soil for range or pasture. Grazing management that maintains an adequate cover of the key plants helps to protect the soil.

This soil is suited to dwellings and septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The slow absorption of liquid waste is a limitation in septic tank absorption fields, but it can be overcome by enlarging the absorption field.

The land capability classification is IIc. The productivity index for spring wheat is 84. The range site is Silty.

16B—Shambo loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on terraces and uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes generally are convex, moderately long, and smooth. Individual areas range from about 10 to 150 acres.

Typically, the surface layer is loam about 9 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is about 32 inches thick. It is brown sandy clay loam in the upper part, grayish brown sandy clay loam in the next part, and grayish brown fine sandy loam in the lower part. The substratum to a depth of about 60 inches is grayish brown fine sandy loam. In some places the surface layer is lighter colored. In other places the soil is dark to a depth of more than 16 inches. In some areas the surface layer is gravelly loam. In other areas the surface layer and the upper part of the subsoil are fine sandy loam.

Included with this soil in mapping are small areas of Amor soils on knobs and Belfield soils in swales. Amor soils have soft bedrock at a depth of 20 to 40 inches. Belfield soils have a silty clay loam and silty clay subsoil. Also included are a few small moderately sloping areas. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Shambo soil. Available water capacity is high, and organic matter content is moderate. Runoff is slow. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. This soil is well suited to small grain and to grasses and legumes. Water erosion is the major management concern. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and a cropping sequence that includes grasses and legumes. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Cover crops, conservation tillage, and a cover of grasses and legumes help to maintain or increase the organic matter content and the rate of water infiltration.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and needleandthread. Crested wheatgrass, smooth bromegrass, green needlegrass, slender wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants. Gullies can form along cattle trails. Cross fencing and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings and septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The slow absorption of liquid waste is a limitation in septic tank absorption fields, but it can be overcome by enlarging the absorption field.

The land capability classification is IIe. The productivity index for spring wheat is 79. The range site is Silty.

17B—Sen silt loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on uplands. Most areas are crossed by shallow drainageways that in places are entrenched. Slopes are convex and smooth. They generally are moderately long but in places are short. Individual areas range from about 10 to 500 acres.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is about 27 inches thick. In sequence downward, it is dark grayish brown silt loam, grayish brown silt loam, light brownish gray silt loam, and pale yellow silty clay loam. Light gray, soft siltstone bedrock is at a depth of about 33 inches. In places the surface layer is calcareous. In a few areas the surface layer and subsoil are loam. In some areas the upper part of the subsoil is silty clay loam.

Included with this soil in mapping are small areas of Arnegard, Grail, and Daglum soils in swales, Cabba soils on convex knobs, and Regent soils on side slopes. Arnegard and Grail soils are deep and are dark to a depth of more than 16 inches. Daglum soils have a dense, alkali subsoil. Cabba soils have a light colored surface layer and have soft bedrock at a depth of 10 to 20 inches. Regent soils have a silty clay loam surface layer. Also included are a few small nearly level areas. Included soils make up 5 to 20 percent of the unit.

Permeability, available water capacity, and organic matter content are moderate in the Sen soil. Runoff is medium. The rooting depth is restricted by the soft bedrock at a depth of about 33 inches. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. This soil is suited to small grain and to grasses and legumes. Water erosion is the major management concern. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and a cropping sequence that includes grasses and legumes. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Cover crops, conservation tillage, and a cover of grasses and legumes help to maintain or increase the organic matter content and the rate of water infiltration.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in protecting this soil. The key range plants are western wheatgrass and needleandthread. Crested wheatgrass, smooth bromegrass, green needlegrass, slender wheatgrass, sweetclover, and alfalfa are suitable hay and pasture plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. A mound system helps to overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification is IIe. The productivity index for spring wheat is 74. The range site is Silty.

17C—Chama-Cabba silt loams, 6 to 9 percent slopes. These moderately sloping, well drained soils are on uplands. Most areas are crossed by shallow drainageways. The moderately deep Chama soil has convex, moderately long, smooth slopes. It is on side slopes. The shallow Cabba soil has convex, short, smooth slopes. It is on the upper side slopes and on knobs and ridges. Individual areas range from about 5 to 250 acres. They are about 50 to 75 percent Chama soil and 20 to 30 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Chama soil has a surface layer of grayish brown silt loam about 8 inches thick. The subsoil is silt loam about 25 inches thick. It is light brownish gray in the upper part and light gray in the lower part. Pale yellow and light gray, soft siltstone bedrock is at a depth of about 33 inches. In some areas the surface layer and subsoil are noncalcareous. In a few places they are loam or silty clay loam.

Typically, the Cabba soil has a surface layer of light brownish gray silt loam about 6 inches thick. The substratum is calcareous silt loam about 10 inches thick. It is pale yellow in the upper part and light brownish gray in the lower part. Pale olive, soft siltstone bedrock is at a depth of about 16 inches. In some areas the surface layer is dark grayish brown. In a few places the surface layer and substratum are loam or silty clay loam.

Included with these soils in mapping are small areas of Arnegard, Belfield, and Grail soils in swales and Moreau and Regent soils on side slopes. Arnegard and Grail soils are deep and are dark to a depth of more than 16 inches. Belfield soils are deep and have a silty clay loam and silty clay subsoil. Moreau and Regent soils have more clay in the subsoil than the Chama soil. Also included are some areas where bedrock is at a depth of 40 to 60 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Chama and Cabba soils. Available water capacity and organic matter content are moderate in the Chama soil and very low in the Cabba soil. Runoff is medium on both soils. The rooting depth is restricted by the bedrock at a depth of about 33 inches in the Chama soil and 16 inches in the Cabba soil. Tilth is good in both soils. The surface layer is friable or very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. These soils are suited to small grain and to grasses and legumes. The major management concerns are the hazards of water erosion and soil blowing and the droughtiness of the Cabba soil. A system of conservation tillage that leaves crop residue on the surface, cover crops, contour stripcropping, windbreaks, grassed waterways in areas where runoff concentrates, a cropping sequence that includes grasses and legumes, and buffer strips help to control soil blowing and water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain the organic matter content, reduce the runoff rate, and improve water infiltration.

The Cabba soil generally is unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Chama soil is suited to nearly all of the climatically adapted species. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in protecting these soils. The key range plants are western wheatgrass, little bluestem, and needleandthread. Crested wheatgrass, smooth bromegrass, green needlegrass, western wheatgrass, sweetclover, and alfalfa are suitable pasture and hay plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The effluent from septic tank systems can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. The absorption fields should be installed on the Chama soil. A mound system helps overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification assigned to the Chama soil is IIIe, and that assigned to the Cabba soil is VIe. The productivity index for spring wheat is 46. The Chama soil is assigned to the Silty range site and the Cabba soil to the Shallow range site.

17D—Chama-Cabba silt loams, 9 to 15 percent slopes. These strongly sloping, well drained soils are on uplands. Most areas are crossed by moderately deep drainageways, but in places drainageways are shallow. The moderately deep Chama soil has convex, moderately long, smooth slopes. It is on side slopes. The shallow Cabba soil has convex, short, smooth slopes. It is on knobs and ridges. Individual areas range from about 5 to 125 acres. They are about 50 to 60 percent Chama soil and 35 to 50 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Chama soil has a surface layer of grayish brown silt loam about 7 inches thick. The subsoil is silt loam about 26 inches thick. It is light brownish gray in the upper part and light gray in the lower part. Pale yellow and light gray, soft siltstone bedrock is at a depth of about 33 inches. In some places the surface layer and subsoil are noncalcareous. In other places they are loam.

Typically, the Cabba soil has a surface layer of light brownish gray silt loam about 6 inches thick. The substratum is silt loam about 10 inches thick. It is pale yellow in the upper part and light brownish gray in the lower part. Pale olive, soft siltstone bedrock is at a depth of about 16 inches. In some places the surface layer is dark grayish brown. In a few areas the surface layer and subsoil are loam or silty clay loam.

Included with these soils in mapping are small areas of Arnegard and Grail soils in swales and Moreau soils on side slopes. Arnegard and Grail soils are deep and are dark to a depth of more than 16 inches. Moreau soils contain more clay in the subsoil than the Chama and Cabba soils. Also included are some areas where bedrock is at a depth of 40 to 60 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Chama and Cabba soils. Available water capacity and organic matter content are moderate in the Chama soil and very low in the Cabba soil. Runoff is medium on both soils. The rooting depth is restricted by the bedrock at a depth of about 33 inches in the Chama soil and 16 inches in the Cabba soil.

Most areas are used as range. A few are used as cropland, pasture, or hayland. Because of a severe hazard of water erosion, a moderate hazard of soil blowing, and the droughtiness of the Cabba soil, these soils are generally unsuited to small grain. They are best suited to range. A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass, little bluestem, and needleandthread. Crested wheatgrass, smooth bromegrass, green needlegrass, western wheatgrass, sweetclover, and alfalfa are suitable hay and pasture plants. Grazing management that maintains an adequate cover of the key plants helps to control water erosion. Gullies can form along cattle trails. Cross fences and a planned grazing system help prevent gullying and improve gullied areas.

The Cabba soil generally is unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Chama soil is suited to nearly all of the climatically adapted species. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The slope is a limitation on sites for dwellings, but it can be overcome by designing the buildings so that they conform to the natural slope of the land. The effluent from septic tank systems can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. Absorption fields should be installed on the Chama soil. A mound system helps overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification assigned to the Chama soil is IVe, and that assigned to the Cabba soil is VIe. The productivity index for spring wheat is 0. The

Chama soil is assigned to the Silty range site and the Cabba soil to the Shallow range site.

18B—Amor loam, 3 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on uplands. Most areas are crossed by shallow drainageways that in places are entrenched. Slopes are convex and smooth. They generally are moderately long but in places are long. Individual areas range from about 10 to 150 acres.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is loam about 28 inches thick. It is brown in the upper part, light brownish gray in the next part, and light gray in the lower part. Light gray and pale yellow, soft siltstone and sandstone bedrock is at a depth of about 36 inches. In places the soil is fine sandy loam, silt loam, or clay loam throughout. In some areas the bedrock is stratified with lignite.

Included with this soil in mapping are small areas of Belfield, Cabba, and Daglum soils. Belfield and Daglum soils are in swales. They are deep and have an alkali subsoil or substratum. Cabba soils have a surface layer that is lighter colored than that of the Amor soil and have soft bedrock at a depth of 10 to 20 inches. They are on knobs. Also included are a few small moderately sloping areas and a few areas where bedrock is at a depth of 40 to 60 inches. Included soils make up 5 to 20 percent of the unit.

Permeability, available water capacity, and organic matter content are moderate in the Amor soil. Runoff is medium. The rooting depth is restricted by the soft bedrock at a depth of about 36 inches. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. This soil is suited to small grain and to grasses and legumes. Water erosion is the major management concern. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and a cropping sequence that includes grasses and legumes. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Cover crops, conservation tillage, and a cover of grasses and legumes help to maintain or increase the organic matter content and the rate of water infiltration.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and needleandthread. Crested wheatgrass, intermediate wheatgrass, smooth bromegrass, green needlegrass, western wheatgrass, alfalfa, and sweetclover are suitable hay and pasture plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The effluent in septic tank absorption fields can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. A mound system helps to overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification is IIe. The productivity index for spring wheat is 71. The range site is Silty.

18C—Amor-Cabba loams, 6 to 9 percent slopes. These moderately sloping, well drained soils are on uplands. Most areas are crossed by shallow drainageways, but in some areas drainageways are entrenched. The moderately deep Amor soil has convex, long slopes. It is on side slopes. The shallow Cabba soil has convex, short slopes. It is on knobs and ridges. Slopes generally are smooth. In some areas of range, however, they are uneven. Individual areas range from about 10 to 150 acres. They are about 50 to 65 percent Amor soil and 30 to 35 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Amor soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is loam about 28 inches thick. It is brown in the upper part, light brownish gray in the next part, and light gray in the lower part. Light gray and pale yellow, soft siltstone and sandstone bedrock is at a depth of about 36 inches. In places the soil is fine sandy loam or clay loam throughout.

Typically, the Cabba soil has a surface layer of light brownish gray loam about 6 inches thick. The substratum is loam about 11 inches thick. It is pale yellow in the upper part and light brownish gray in the lower part. Pale olive, soft bedrock is at a depth of 17 inches. In some places the surface layer and substratum are fine sandy loam or silt loam. In other places the surface layer is dark grayish brown.

Included with these soils in mapping are small areas of Arnegard and Daglum soils in swales and Moreau and

Regent soils on side slopes. Arnegard soils are deep and are dark to a depth of more than 16 inches. Daglum soils have an alkali subsoil. Moreau and Regent soils have more clay in the subsoil than the Amor soil. Also included are some areas where bedrock is at a depth of 40 to 60 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Amor and Cabba soils. Available water capacity and organic matter content are moderate in the Amor soil and very low in the Cabba soil. Runoff is medium on both soils. The rooting depth is restricted by the bedrock at a depth of about 36 inches in the Amor soil and 17 inches in the Cabba soil. Tilth is good in both soils. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. These soils are suited to small grain and to grasses and legumes. The major management concerns are the hazards of water erosion and soil blowing and the droughtiness of the Cabba soil. A system of conservation tillage that leaves crop residue on the surface, cover crops, stripcropping, windbreaks, grassed waterways in areas where runoff concentrates, a cropping sequence that includes grasses and legumes, and buffer strips help to control soil blowing and water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain the organic matter content, reduce the runoff rate, and improve water infiltration.

The Cabba soil generally is unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Amor soil is suited to nearly all of the climatically adapted species. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in protecting these soils. The key range plants are western wheatgrass, little bluestem, and needleandthread. Crested wheatgrass, intermediate wheatgrass, smooth bromegrass, green needlegrass, western wheatgrass, alfalfa, and sweetclover are suitable hay and pasture plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The effluent from septic tank absorption systems can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. Absorption fields should be installed on the Amor soil. A mound system helps overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification assigned to the Amor soil is IIIe, and that assigned to the Cabba soil is VIe. The productivity index for spring wheat is 46. The Amor soil is assigned to the Silty range site and the Cabba soil to the Shallow range site.

18D—Amor-Cabba loams, 9 to 15 percent slopes. These strongly sloping, well drained soils are on uplands. Most areas are crossed by shallow or moderately deep drainageways. The moderately deep Amor soil has convex, moderately long, smooth slopes. It is on side slopes. The shallow Cabba soil has convex, short, smooth slopes. It is on knobs and ridges. Individual areas range from about 10 to 150 acres. They are about 55 to 65 percent Amor soil and 30 to 45 percent Cabba soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Amor soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is loam about 28 inches thick. It is brown in the upper part, light brownish gray in the next part, and light gray in the lower part. Light gray and pale yellow, soft siltstone and sandstone bedrock is at a depth of about 36 inches. In places the soil is silt loam or clay loam throughout.

Typically, the Cabba soil has a surface layer of light brownish gray loam about 6 inches thick. The substratum is loam about 11 inches thick. It is pale yellow in the upper part and light brownish gray in the lower part. Pale olive, soft bedrock is at a depth of about 17 inches. In places the surface layer and subsoil are clay loam or fine sandy loam.

Included with these soils in mapping are small areas of Moreau and Regent soils on side slopes and Daglum and Savage soils in swales. Moreau, Regent, and Savage soils have more clay in the subsoil than the Amor soil. Savage soils are deep. Daglum soils also are deep and have a dense, alkali subsoil. Also included are some areas where bedrock is at a depth of 20 to 40 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Amor and Cabba soils. Available water capacity and organic matter content are moderate in the Amor soil and very low in the Cabba soil. Runoff is rapid on both soils. The rooting depth is restricted by the bedrock at a depth of about 36 inches in the Amor soil and at 17 inches in the Cabba soil.

Most areas are used as range. A few are used as cropland, pasture, or hayland. Because of a severe hazard of water erosion and the droughtiness of the

Cabba soil, these soils are generally unsuited to small grain. They are best suited to range. A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass, little bluestem, and needleandthread. Crested wheatgrass, intermediate wheatgrass, smooth bromegrass, green needlegrass, western wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants.

The Cabba soil generally is unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Amor soil is suited to nearly all of the climatically adapted species. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

These soils are suited to dwellings but are poorly suited to septic tank absorption fields. A moderate shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The depth to bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The slope is a limitation on sites for dwellings, but it can be overcome by designing the buildings so that they conform to the natural slope of the land. The effluent from septic tank systems can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. Absorption fields should be installed on the Amor soil. A mound system helps overcome the depth to bedrock. If this limitation cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification assigned to the Amor soil is IVe, and that assigned to the Cabba soil is VIe. The productivity index for spring wheat is 0. The Amor soil is assigned to the Silty range site and the Cabba soil to the Shallow range site.

19F—Cabba-Chama silt loams, 15 to 70 percent slopes. These well drained soils are on uplands. Most areas are crossed by moderately deep drainageways. Slumping and slippage occur in many areas. The shallow, moderately steep to very steep Cabba soil has convex, short, uneven slopes. It is on knobs and ridges. The moderately deep, moderately steep to steep Chama soil has convex, moderately long, smooth slopes. It is on side slopes. Individual areas range from about 10 to 250 acres. They are about 50 to 65 percent Cabba soil and 20 to 45 percent Chama soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabba soil has a surface layer of grayish brown silt loam about 4 inches thick. The substratum is silt loam about 13 inches thick. It is pale yellow in the upper part and light brownish gray in the lower part. Pale olive, soft bedrock is at a depth of about 17 inches. In some places the surface layer and substratum are fine sandy loam, silty clay loam, or silty clay. In other places the surface layer is dark grayish brown. In a few areas it is gravelly or very gravelly loam.

Typically, the Chama soil has a surface layer of grayish brown silt loam about 6 inches thick. The subsoil is silt loam about 27 inches thick. It is light brownish gray in the upper part and light gray in the lower part. Pale yellow and light gray, soft siltstone bedrock is at a depth of about 33 inches. In some places the soil is loam or silty clay loam throughout. In other places the surface layer is gravelly or very gravelly loam.

Included with these soils in mapping are small areas of Daglum and Savage soils in swales, Harriet and Straw soils in drainageways, and Regent soils on side slopes. Daglum soils have a dense, alkali subsoil. Harriet soils are poorly drained. Regent and Savage soils have more clay in the subsoil than the Cabba and Chama soils. Straw soils are deep and are dark to a depth of more than 16 inches. Also included are small very stony areas where bedrock crops out and a few areas where bedrock is within a depth of 10 inches or at a depth of 40 to 60 inches. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Cabba and Chama soils. Available water capacity is very low in the Cabba soil and moderate in the Chama soil. Organic matter content is low in the Cabba soil and moderate in the Chama soil. Runoff is very rapid on both soils. The rooting depth is restricted by the bedrock at a depth of about 17 inches in the Cabba soil and 33 inches in the Chama soil.

Most areas are used as range. Some small areas are used for hay or cultivated crops. Because of the moderately steep to very steep slope and the shallow depth of the Cabba soil, these soils are generally unsuited to cultivated crops, trees, and shrubs. They are best suited to range. A cover of range plants is effective in controlling erosion. The key range plants are western wheatgrass, little bluestem, and needleandthread. Soil blowing, water erosion, and the very low or moderate available water capacity are problems in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. The slope limits the use of machinery. Grazing management that maintains an adequate cover of the key plants helps to trap snow, control soil blowing and water erosion, and prevent denuding. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

These soils are poorly suited to dwellings and generally unsuited to septic tank absorption fields. The slope is a limitation on sites for dwellings, but it can be overcome by designing the buildings so that they conform to the natural slope of the land. The depth to bedrock also is a limitation, but the rock is soft and can be easily excavated. Soil slumping is a hazard, particularly during periods of high precipitation. Alternative sites for septic tank absorption fields or alternative disposal systems should be considered.

The land capability classification assigned to the Cabba soil is VIIe, and that assigned to the Chama soil is VIe. The productivity index for spring wheat is 0. The Cabba soil is assigned to the Shallow range site and the Chama soil to the Silty range site.

20F—Flasher-Beisigl-Lihen complex, 6 to 70 percent slopes. These soils are on uplands. Most areas are crossed by shallow or moderately deep drainageways. Slumping and slippage occur in most areas. About 10 to 40 percent of the surface of the Flasher and Beisigl soils is covered with boulders and stones, which are about 2 feet in diameter but range from less than 10 inches to more than 5 feet (fig. 9). Only a few stones are on the surface of the Lihen soil.

The shallow, somewhat excessively drained, strongly sloping to very steep Flasher soil has convex, short, uneven slopes. It is on knobs, ridges, and buttes. The moderately deep, somewhat excessively drained, moderately sloping to steep Beisigl soil has convex, moderately long, uneven slopes. It is on side slopes. The deep, moderately sloping and strongly sloping, well drained Lihen soil has concave, moderately long, smooth slopes. It is on the lower side slopes and in small valleys and swales between hills. Individual areas range from about 10 to 150 acres. They are about 30 to 40 percent Flasher soil, 30 to 35 percent Beisigl soil, and 25 to 35 percent Lihen soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Flasher soil has a surface layer of grayish brown extremely stony loamy fine sand about 3 inches thick. The next layer is light olive brown loamy fine sand about 7 inches thick. The substratum also is loamy fine sand about 7 inches thick. It is light olive brown in the upper part and grayish brown in the lower part. Light yellowish brown, soft sandstone bedrock is at a depth of about 17 inches. In places the surface layer and substratum are loam or fine sandy loam.

Typically, the Beisigl soil has a surface layer of grayish brown extremely stony loamy fine sand about 5 inches thick. The subsoil is loamy fine sand about 22 inches thick. It is light yellowish brown in the upper part and

Figure 9.—Stones on the surface of Flasher and Beisigl soils.

pale yellow in the lower part. Pale yellow, soft sandstone bedrock is at a depth of about 27 inches. In places the surface layer and subsoil are fine sandy loam.

Typically, the Lihen soil has a surface soil of loamy fine sand about 18 inches thick. It is grayish brown in the upper part and brown in the lower part. The subsoil is about 27 inches thick. It is brown loamy fine sand in the upper part and light olive brown fine sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand. In places the surface layer and substratum are fine sandy loam.

Included with these soils in mapping are small areas of Sen and Amor soils on side slopes and Ekalaka soils on the lower side slopes and in swales. Sen soils have a dark surface layer of silt loam, and Amor soils have one of loam. Ekalaka soils have a dense, alkali subsoil. Also included are some areas where soft sandstone bedrock is at a depth of 40 to 60 inches and a few areas where hard sandstone bedrock is within a depth of 10 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is rapid in the Flasher, Beisigl, and Lihen soils. Available water capacity is very low in the Flasher and Beisigl soils and low in the Lihen soil. Organic matter content is low in the Flasher soil and moderately low in the Beisigl and Lihen soils. Runoff is medium on all three soils. The rooting depth is restricted by the sandstone at a depth of about 17 inches in the Flasher soil and 27 inches in the Beisigl soil.

Most areas are used as range. Some small areas of the Lihen soil are used for hay or cultivated crops. Because of the stoniness of the Flasher and Beisigl soils and the slope of all three soils, this unit is generally unsuited to cultivated crops. It is best suited to range. A cover of range plants is effective in controlling erosion. The key range plants are needleandthread, little bluestem, and prairie sandreed. Soil blowing and the very low or low available water capacity are problems in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. The slope limits the use of machinery. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing and prevents denuding.

The Flasher and Beisigl soils are generally unsuited to the trees and shrubs grown as windbreaks and environmental plantings. The Lihen soil is suited to many of the climatically adapted species. It is somewhat droughty, and moisture stress is common, particularly during periods when the trees and shrubs are becoming established. Irrigation during these periods helps to ensure survival of the seedlings. Little benefit is derived from fallowing during the season prior to planting because of the limited available water capacity. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

These soils are poorly suited to dwellings and generally unsuited to septic tank absorption fields. The slope is a limitation on sites for dwellings, but it can be overcome by designing the buildings so that they conform to the natural slope of the land. The bedrock is a limitation on sites for dwellings with basements, but the rock is soft and can be easily excavated. The Lihen soil is better suited to septic tank absorption fields than the Flasher and Beisigl soils. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. A mound system helps to overcome the poor filtering capacity. It also helps to overcome the depth to bedrock in the Lihen and Beisigl soils. If these limitations cannot be overcome, alternative sites or disposal systems should be considered.

The land capability classification assigned to the Flasher and Beisigl soils is VIIs, and that assigned to the Lihen soil is VIe. The productivity index for spring wheat is 0. The Flasher soil is assigned to the Shallow range site and the Beisigl and Lihen soils to the Sands range site.

21—Ruso fine sandy loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on terraces. It is moderately deep over sand and gravel. Most areas are crossed by indistinct or shallow drainageways. Slopes generally are plane, long, and smooth. Individual areas range from about 10 to 200 acres.

Typically, the surface soil is grayish brown fine sandy loam about 10 inches thick. The subsoil is about 19 inches thick. It is brown. It is fine sandy loam in the upper part and loamy fine sand in the lower part. The substratum to a depth of about 60 inches is light brownish gray gravelly sand. In places the soil is dark to a depth of only 8 to 16 inches. In a few places the depth to sand and gravel is more than 40 inches. In some areas the surface layer and subsoil are loam. In a few areas the surface layer is gravelly or very gravelly loam or fine sandy loam.

Included with this soil in mapping are small areas of Arnegard soils in swales and, on terrace edges, small areas of a soil that has sand and gravel within a depth of 10 inches. Arnegard soils are dark to a depth or more than 16 inches. Also included are some gently sloping areas. Included soils make up 5 to 20 percent of the unit.

Permeability is moderately rapid in the upper part of the Ruso soil and very rapid in the lower part. Available water capacity is low, and organic matter content is moderate. Runoff is slow. The rooting depth is restricted by the sand and gravel at a depth of about 29 inches. Tilth is good. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. This soil is suited to small grain and to grasses and legumes. The main management concerns are soil blowing and droughtiness. Windbreaks, buffer strips, a system of conservation tillage that leaves crop residue on the surface, stripcropping, and a cropping sequence that includes grasses and legumes help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife and conserves moisture.

This soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings. It is droughty, and moisture stress is common. Irrigation helps to ensure survival of the seedlings. Little benefit is derived from fallowing during the season prior to planting because of the limited available water capacity of the soil. Removing grasses and weeds before the trees are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are needleandthread and prairie sandreed. Crested wheatgrass, intermediate wheatgrass, smooth bromegrass, little bluestem, western wheatgrass, sweetclover, and alfalfa are suitable pasture and hay plants. Soil blowing and the low available water capacity are problems in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing and prevents denuding.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent from septic tank systems. The poor filtering capacity may result in the pollution of ground water. It can be overcome by a mound system. The sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored.

The land capability classification is IIIe. The productivity index for spring wheat is 46. The range site is Sandy.

22—Bowdle loam, 0 to 3 percent slopes. This deep, level and nearly level, well drained soil is on terraces. It is moderately deep over sand and gravel. Most areas are crossed by shallow or indistinct drainageways. Slopes generally are plane, long, and smooth. Individual areas range from about 10 to 500 acres.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is about 26 inches thick. In sequence downward, it is dark brown loam, brown loam, light brownish gray loam, and grayish brown gravelly sandy loam. The upper part of the substratum is light brownish gray very gravelly loamy sand. The lower part to a depth of about 60 inches is light olive brown, stratified sand and gravel. In some areas the depth to sand and gravel is about 15 inches, and in a few places it is more than 40 inches. In some places the soil is dark to a depth of less than 16 inches. In other places it is fine sandy loam throughout. In a few areas the surface layer is gravelly or very gravelly loam or fine sandy loam. In some areas it is lighter colored when dry.

Included with this soil in mapping are small areas of Shambo soils on slight rises and, on terrace edges, small areas of a soil that has sand and gravel within a depth of 10 inches. Shambo soils have a fine sandy loam substratum. Also included are some gently sloping areas and a few areas where loam or sandy loam is at a depth of 40 to 60 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the upper part of the Bowdle soil and rapid in the lower part. Available water capacity and organic matter content are moderate. Runoff is slow. The rooting depth is restricted by the sand and gravel at a depth of about 31 inches. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. This soil is suited to small grain and to grasses and legumes. The major management concerns are reducing the droughtiness and maintaining tilth and fertility. A system of conservation tillage that leaves crop residue on the surface, cover crops, and a cropping sequence that includes grasses and legumes increase or maintain the organic matter content and improve water infiltration. They also increase the moisture supply by trapping snow. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

This soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings. It is droughty, and moisture stress is common. Irrigation helps to ensure survival of the seedlings. Little benefit is derived from fallowing during the season prior to planting because of the limited available water capacity. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in protecting this soil. The key range plants are western wheatgrass and needleandthread. Crested wheatgrass, smooth bromegrass, green needlegrass, slender wheatgrass, western wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. No major hazards or limitations affect the use of this soil for range or pasture. Grazing management that maintains an adequate cover of the key plants helps to protect the soil.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent from septic tank systems. The poor filtering capacity may result in the pollution of ground water. It can be overcome by a mound system. The sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored.

The land capability classification is IIIs. The productivity index for spring wheat is 59. The range site is Silty.

22B—Bowdle loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on terraces. It is moderately deep over sand and gravel. Most areas are crossed by shallow or deep drainageways that in places are entrenched. Slopes generally are plane, short, and smooth. Individual areas range from about 10 to 100 acres.

Typically, the surface layer is dark grayish brown loam about 5 inches thick. The subsoil is about 26 inches thick. In sequence downward, it is dark brown loam, brown loam, light brownish gray loam, and grayish brown gravelly sandy loam. The upper part of the substratum is light brownish gray very gravelly loamy sand. The lower part to a depth of about 60 inches is light olive brown, stratified sand and gravel. In some areas the depth to sand and gravel is about 15 inches, and in a few places it is more than 40 inches. In places the surface layer is lighter colored when dry.

Included with this soil in mapping are small areas of Shambo soils on slight rises and, on terrace edges, small areas of a soil that has sand and gravel within a depth of 10 inches. Shambo soils have a fine sandy loam substratum. Also included are some small moderately sloping areas. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the upper part of the Bowdle soil and rapid in the lower part. Available water capacity and organic matter content are moderate. Runoff is slow. The rooting depth is restricted by the sand and gravel at a depth of about 31 inches. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. This soil is suited to small grain and to grasses and legumes. The major management concerns are droughtiness and water erosion. A system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and a cropping sequence that includes grasses and legumes help to control water erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Cover crops, conservation tillage, and a cover of grasses and legumes help to maintain or increase the organic matter content and improve water infiltration. They also increase the moisture supply by trapping snow.

This soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings. It is droughty, and moisture stress is common. Irrigation helps to ensure survival of the seedlings. Little benefit is derived from fallowing during the season prior to planting because of the limited available water capacity of the soil. Removing grasses and weeds before the trees are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and needleandthread. Crested wheatgrass, smooth bromegrass, green needlegrass, slender wheatgrass, western wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent from septic tank systems. The poor filtering capacity may result in the pollution of ground water. It can be overcome by a mound system. The sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored.

The land capability classification is IIIe. The productivity index for spring wheat is 54. The range site is Silty.

23F—Flasher-Beisigl-Rock outcrop complex, 9 to 70 percent slopes. This map unit consists of somewhat excessively drained soils intermingled with Rock outcrop. It is on uplands. Most areas are crossed by shallow drainageways that in places are entrenched. Slumping and slippage occur in many areas. The shallow, strongly sloping to very steep Flasher soil has convex, short, uneven slopes. It is on the tops and upper shoulder slopes of ridges, hills, and buttes. The moderately deep, strongly sloping to steep Beisigl soil has convex, moderately long, smooth slopes. It is on the lower side slopes. The Rock outcrop is hard sandstone on the tops and shoulder slopes of hills, ridges, and buttes. Individual areas range from about 10 to 600 acres. They are about 45 to 60 percent Flasher soil, 20 to 35 percent Beisigl soil, and 5 to 15 percent Rock outcrop. The two soils and the Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Flasher soil has a surface layer of grayish brown loamy fine sand about 3 inches thick. The next layer is light olive brown loamy fine sand about 7 inches thick. The substratum is calcareous loamy fine sand about 7 inches thick. It is light olive brown in the upper part and grayish brown in the lower part. Light yellowish brown, soft sandstone bedrock is at a depth of about 17 inches. In some places the surface layer and substratum are fine sandy loam, loam, or silt loam. In other places, generally near the larger streams, they are very gravelly loamy sand.

Typically, the Beisigl soil has a surface layer of grayish brown loamy fine sand about 5 inches thick. The subsoil is loamy fine sand about 22 inches thick. It is light yellowish brown in the upper part and pale yellow in the lower part. Pale yellow, soft sandstone bedrock is at a depth of about 27 inches. In some places the surface layer is thicker and is dark grayish brown. In other places the surface layer and substratum are fine sandy loam. In a few areas, generally near the larger streams, the surface layer is very gravelly loamy fine sand.

Included in this unit in mapping are small areas of Lihen and Parshall soils in swales and Regan soils in drainageways. Lihen and Parshall soils are dark to a depth of more than 16 inches. Also, Parshall soils typically are fine sandy loam throughout. Regan soils are poorly drained. They have a layer of accumulated lime within a depth of 16 inches. Also included are areas of a soil having sand and gravel at a depth of about 15 inches, some very stony areas, and a few areas where sandstone is at a depth of 40 to 60 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is rapid in the Flasher and Beisigl soils. Available water capacity is very low. Organic matter content is low in the Flasher soil and moderately low in the Beisigl soil. Runoff is rapid on both soils. The rooting depth is restricted by the sandstone at a depth of about 17 inches in the Flasher soil and 27 inches in the Beisigl soil.

Most areas are used as range. Some small areas are used for cultivated crops or hay. Generally, the cultivated areas are on the lower side slopes and in drainageways. Because of the slope, the Rock outcrop, and the shallow rooting depth in the Flasher soil, this unit is generally unsuited to cultivated crops, trees, and shrubs. It is best suited to range. A cover of range plants is effective in controlling erosion. The key range plants are needleandthread, little bluestem, and prairie sandreed. Soil blowing, water erosion, and the very low available water capacity are problems in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. The slope limits the use of machinery. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing and water erosion. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

The Flasher and Beisigl soils are poorly suited to dwellings and generally unsuited to septic tank absorption fields. The slope is a limitation on sites for dwellings, but it can be overcome by designing the buildings so that they conform to the natural slope of the land. The depth to bedrock is a limitation on sites for dwellings with basements, but the bedrock is soft and can be easily excavated. Alternative sites for septic tank absorption fields or alternative disposal systems should be considered.

The land capability classification assigned to the Flasher soil is VIIe, and that assigned to the Beisigl soil is VIe. The productivity index for spring wheat is 0. The Flasher soil is assigned to the Shallow range site and the Beisigl soil to the Sands range site.

24—Straw loam, 0 to 3 percent slopes. This deep, level and nearly level, well drained soil is on flood plains. It generally is occasionally flooded, but in places it is only rarely flooded. Most areas are crossed by indistinct drainageways. Slopes generally are plane, long, and smooth. Along terrace edges, however, they are short and convex. Individual areas range from about 10 to 600 acres.

Typically, the surface soil is dark grayish brown loam about 18 inches thick. The substratum to a depth of about 60 inches is loam. It is grayish brown in the upper part, light brownish gray in the next part, and grayish brown in the lower part. In some places the surface soil is dark to a depth of only 8 to 16 inches. In other places the surface soil and substratum are fine sandy loam. In some areas the surface layer is clay loam or silt loam, and in a few areas it is calcareous and stratified.

Included with this soil in mapping are small areas of a poorly drained soil in oxbows and abandoned stream channels and a well drained soil having a dense, alkali subsoil. Also included are a few small gently sloping areas and a few abandoned stream channels and oxbows. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Straw soil. Available water capacity and organic matter content are high. Runoff is slow. The soil receives runoff from the adjacent areas. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as range. This soil is well suited to small grain and to grasses and legumes. The main management concern is maintaining tilth and fertility. A system of conservation tillage that leaves crop residue on the surface, cover crops, and a cropping sequence that includes grasses and legumes help to maintain or increase the organic matter content, improve water infiltration, and conserve moisture. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Flooding generally occurs after snowmelt and before the crops are planted.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect survival or growth. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and needleandthread. Altari wildrye, intermediate wheatgrass, smooth bromegrass, green needlegrass, slender wheatgrass, and alfalfa are suitable pasture and hay plants. No major hazards or limitations affect the use of this soil for range. Grazing management that maintains an adequate cover of the key plants helps to protect the soil.

This soil generally is unsuited to dwellings and septic tank absorption fields because of the flooding. Soils that are better suited to these uses generally are nearby.

The land capability classification is IIc. The productivity index for spring wheat is 90. The range site is Silty.

25B—Lihen loamy fine sand, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is in swales on uplands. Most areas are crossed by shallow or indistinct drainageways, but in places drainageways are entrenched. Slopes generally are concave, moderately long, and smooth, but in places they are complex and hummocky. Individual areas range from about 10 to 100 acres.

Typically, the surface soil is loamy fine sand about 18 inches thick. It is grayish brown in the upper part and brown in the lower part. The subsoil is about 27 inches thick. It is brown loamy fine sand in the upper part and light olive brown fine sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown loamy fine sand. In places the surface layer and substratum are fine sandy loam.

Included with this soil in mapping are small areas of Beisigl and Vebar soils on small knobs and Regan soils in drainageways. Beisigl and Vebar soils have soft sandstone at a depth of 20 to 40 inches. Regan soils are poorly drained. They have a layer of accumulated lime within a depth of 16 inches. Also included are a few small moderately sloping areas and a few areas of blowouts that support no vegetation. Included soils make up 5 to 20 percent of the unit.

Permeability is rapid in the Lihen soil. Available water capacity is low, and organic matter content is moderately low. Runoff is slow. Tilth is good. The surface layer is loose and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops, hay, or pasture. Some are used as range. This soil is poorly suited to small grain but is suited to grasses and legumes. The main management concerns are soil blowing and droughtiness. Intensive management is needed to control soil blowing. This management includes a system of conservation tillage that leaves crop residue on the surface, stripcropping, buffer strips, windbreaks, cover crops, and a cropping sequence that includes grasses and legumes. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain or increase the organic matter content and improve water infiltration. They also increase the moisture supply by trapping snow.

This soil is suited to many of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. It is somewhat droughty, and moisture stress is common, particularly during periods when the trees and shrubs are becoming established. Irrigation during these periods helps to ensure survival of the seedlings. Little benefit is derived from fallowing during the season prior to planting because of the limited available water capacity of the soil. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are needleandthread and prairie sandreed. Intermediate wheatgrass, prairie sandreed, slender wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Soil blowing and the low available water capacity are problems in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing and prevents denuding.

This soil is suited to dwellings but is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent from septic tank systems. The poor filtering capacity may result in the pollution of ground water. It can be overcome by a mound system. The sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored.

The land capability classification is IVe. The productivity index for spring wheat is 41. The range site is Sands.

26—Regan silt loam, 0 to 3 percent slopes. This deep, level and nearly level, poorly drained, highly calcareous soil is in drainageways and seepy areas on uplands. It is occasionally flooded. Slopes generally are concave, long, and smooth, but in places they are slightly hummocky. Individual areas range from about 10 to 120 acres.

Typically, the surface layer is dark gray and very dark gray silt loam about 7 inches thick. The next layer is gray loam about 3 inches thick. The subsoil is about 10 inches thick. It is gray and light gray clay loam in the upper part and light gray, mottled loam in the lower part.

The substratum to a depth of about 60 inches is mottled. In sequence downward, it is light brownish gray loam, light brownish gray clay loam, light gray sandy clay loam, and gray clay loam. In some places the surface layer and substratum are fine sandy loam, loam, silt loam, or loamy sand. In other places a thin alkaline subsoil is at a depth of about 5 inches. In a few areas the surface is extremely stony.

Included with this soil in mapping are small areas of the well drained Parshall soils. These soils do not have a layer of accumulated lime within a depth of 16 inches. They make up 5 to 20 percent of the unit.

Permeability and available water capacity are moderate in the Regan soil. Organic matter content is high. Runoff is very slow. A seasonal high water table is within a depth of 1 foot.

Most areas are used as range. Some are used for cultivated crops or hay. This soil is poorly suited to small grain, trees, and shrubs because of wetness and salinity. The hazard of soil blowing is moderate. Areas that are used for cultivated crops generally become increasingly saline with each succeeding cropping year. Drainage outlets are difficult to locate.

A cover of range plants is effective in controlling erosion. The key range plants are little bluestem, switchgrass, and big bluestem. No major hazards or limitations affect the use of this soil for range. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing.

If drained, this soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Undrained areas, however, generally are unsuited. The wetness is a critical limitation affecting survival, growth, and vigor. In drained areas reduction of the evaporation rate at the surface increases the seedling survival rate. If the soil is bare as it dries, salt-laden water tends to move to the surface. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

This soil generally is unsuited to dwellings and septic tank absorption fields because of the wetness and the flooding. Soils that are better suited to these uses generally are nearby.

The land capability classification is IIw. The productivity index for spring wheat is 35 to 65, depending on the degree of drainage. The range site is Subirrigated.

27E—Sinnigam-Daglum complex, 1 to 25 percent slopes. These soils are on uplands that generally are crossed by shallow drainageways. Slumping or slippage occurs in most areas. The shallow, well drained, nearly level and gently sloping Sinnigam soil has plane, moderately long, smooth slopes. It is on the tops of buttes. The moderately deep, well drained and moderately well drained, gently sloping to moderately steep, alkali Daglum soil has convex, moderately long, uneven slopes. It is on side slopes. About 5 to 20 percent of the surface of the Sinnigam soil is covered with stones and boulders. Individual areas range from about 10 to 250 acres. They are about 45 to 60 percent Sinnigam soil and 30 to 50 percent Daglum soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Sinnigam soil has a surface layer of grayish brown very stony loam about 2 inches thick. The subsoil is about 11 inches thick. It is brown. It is very channery clay loam in the upper part and very channery clay in the lower part. White, hard bedrock is at a depth of about 13 inches. In a few places the bedrock is soft. In some areas the depth to hard bedrock is about 5 inches.

Typically, the Daglum soil has a surface layer of grayish brown silt loam about 5 inches thick. The subsurface layer is light gray loam about 3 inches thick. The subsoil is about 16 inches thick. It is brown clay in the upper part and grayish brown clay loam in the lower part. The substratum is dark grayish brown silty clay about 10 inches thick. Dark grayish brown, lignitic shale bedrock is at a depth of about 34 inches. In some places the subsurface layer, subsoil, and substratum have rock fragments 3 to 15 inches in diameter. In other places the depth to the subsoil is about 5 inches. In a few places the surface layer is fine sandy loam. In some areas the subsoil contains less clay.

Included with these soils in mapping are small areas of Amor, Belfield, and Watrous soils and shale outcrop. Amor soils are loam throughout and have soft bedrock at a depth of 20 to 40 inches. Belfield soils are deep and have a dense, alkali subsoil. They are in swales. Watrous soils have hard bedrock at a depth of 20 to 30 inches. Included areas make up 5 to 20 percent of the unit.

Permeability is moderately slow in the Sinnigam soil and very slow in the Daglum soil. Available water capacity is low in the Sinnigam soil and moderate in the Daglum soil. Organic matter content is moderately low in both soils. Runoff is rapid. The rooting depth is restricted by the bedrock at a depth of about 13 inches in the Sinnigam soil and by the dense subsoil at a depth of about 8 inches in the Daglum soil.

Most areas are used as range. Some small areas where the stones have been removed are used as cropland. Because of droughtiness, stoniness, the slope, and the depth to hard bedrock in the Sinnigam soil, these soils are generally unsuited to small grain, trees, shrubs, and grasses and legumes. They are best suited to range. A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass, needleandthread, and blue grama. Water erosion and the low or moderate available water capacity are problems in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. The stones and boulders limit the use of machinery.

Grazing management that maintains an adequate cover of the key plants helps to trap snow and control water erosion. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

These soils are generally unsuited to dwellings and septic tank absorption fields because of the slope, the stoniness, the depth to hard bedrock, and the slow or very slow permeability. Soils that are better suited to these uses generally are nearby.

The land capability classification assigned to the Sinnigam soil is VIIs, and that assigned to the Daglum soil is IVs. The productivity index for spring wheat is 0. The Sinnigam soil is assigned to the Shallow to Gravel range site and the Daglum soil to the Claypan range site.

28—Harriet loam. This deep, level, poorly drained, alkali, moderately saline soil is on flood plains. It is occasionally flooded following snowmelt and heavy rains. Slopes generally are plane, moderately long, and smooth, but in places they are short and hummocky. Individual areas range from about 5 to 250 acres in size.

Typically, the surface layer is gray loam about 3 inches thick. The subsoil is grayish brown clay about 43 inches thick. It is mottled between depths of 16 and 46 inches. The substratum to a depth of about 60 inches is light brownish gray, mottled clay loam. In some places the surface layer is fine sandy loam, clay loam, or silt loam. In other places the substratum is stratified with loam or sandy loam. In a few areas the depth to salts and carbonates is more than 10 inches.

Included with this soil in mapping are small areas of Daglum, Parshall, and Straw soils. Daglum soils are moderately well drained, and Parshall and Straw soils are well drained. All of the included soils are in the higher lying areas. They make up 5 to 20 percent of the unit.

Permeability is very slow in the Harriet soil. Available water capacity and organic matter content are moderate. Runoff is very slow. The content of salts restricts the growth of plants, and the dense, alkali subsoil restricts the rooting depth. A seasonal high water table is within a depth of 1 foot.

Most areas are used as range. Some are used as cropland, native hayland, or pasture. This soil generally is unsuited to small grain, trees, shrubs, and most tame grasses and legumes because of salinity, alkalinity, and wetness. A cover of range plants is effective in controlling erosion. The key range plants are Nuttall alkaligrass, inland saltgrass, and western wheatgrass. The high content of salts reduces the amount of water available to plants. Compaction, trampling, and root damage are problems, especially if the range is grazed during wet periods. They can be prevented by deferring grazing when the soil is wet. Stock water ponds constructed in this soil frequently contain salty water.

This soil generally is unsuited to dwellings and septic tank absorption fields because of the wetness and the flooding. Soils that are better suited to these uses generally are nearby.

The land capability classification is VIs. The productivity index for spring wheat is 0. The range site is Saline Lowland.

29—Korchea loam. This deep, level, well drained soil is on flood plains. It is occasionally flooded. Slopes generally are plane, long, and smooth. Individual areas range from 10 to 1,000 acres.

Typically, the surface layer is grayish brown loam about 9 inches thick. The upper part of the substratum is grayish brown loam. The next part is dark grayish brown loam. The lower part to a depth of about 60 inches is grayish brown, stratified loam and fine sandy loam. In some areas the surface layer is fine sandy loam, and in a few places it is silt loam or clay loam. In places the substratum is fine sandy loam. In a few areas the soil is dark to a depth of more than 16 inches.

Included with this soil in mapping are small areas of a poorly drained soil in abandoned stream channels and oxbows. Also included are a few small gently sloping areas and a few areas where the soil is moderately well drained. Included soils make up 5 to 20 percent of the unit.

Permeability and organic matter content are moderate in the Korchea soil. Available water capacity is high. Runoff is slow. Tilth is good. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content.

Most areas are used as range. Some are used for cultivated crops, hay, or pasture. This soil is well suited to small grain and to grasses and legumes. The main management concern is maintaining tilth and fertility. Conservation tillage, cover crops, and a cropping sequence that includes grasses and legumes help to maintain or increase the organic matter content, maintain soil tilth and fertility, improve water infiltration, and conserve moisture. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Flooding generally occurs after snowmelt and before the crops are planted.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect survival or growth. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and needleandthread. Altari wildrye, crested wheatgrass, smooth bromegrass, green needlegrass, alfalfa, and sweetclover are suitable pasture and hay plants. No major hazards or limitations affect the use of this soil for range or pasture. Grazing management that maintains an adequate cover of the key plants helps to protect the soil.

This soil generally is unsuited to dwellings and septic tank absorption fields because of the flooding. Soils that are better suited to these uses generally are nearby.

The land capability classification is IIc. The productivity index for spring wheat is 86. The range site is Silty.

30—Straw loam, channeled. This deep, level, well drained soil is on flood plains. Most areas are in narrow valleys, but some are on broad bottom land. All areas are dissected by meandering stream channels (fig. 10). The soil is frequently flooded following snowmelt and heavy rains. Slopes are plane, short, and smooth. Individual areas range from about 10 to 100 acres.

Typically, the surface soil is dark grayish brown loam about 18 inches thick. The substratum to a depth of about 60 inches is loam. It is grayish brown in the upper part, light brownish gray in the next part, and grayish brown in the lower part. In some areas the soil is dark to a depth of only 8 to 16 inches. In other areas the surface layer and substratum are fine sandy loam.

Included with this soil in mapping are small areas of Cabba soils and a soil that has an alkali subsoil. Cabba soils have bedrock at a depth of 10 to 20 inches. They are on escarpments between the flood plains and the uplands. Also included is a poorly drained soil in abandoned stream channels. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Straw soil. Available water capacity and organic matter content are high. Runoff is slow.

Most areas are used as range or wildlife habitat. A few are used for cultivated crops. This soil generally is unsuited to small grain and machine-planted trees and shrubs because of the entrenched meandering stream channels, the steep valley sidewalls, and the escarpments. Hand-planted trees and shrubs can be grown. The main concern in managing wildlife habitat is maintaining the diversity of plants. Some areas support

Figure 10.—An area of Straw loam, channeled. The hay is in an area of Korchea loam.

small groves of native trees and shrubs. Tillable areas generally are small and irregular in shape.

A cover of range plants is effective in controlling erosion. The key range plants are big bluestem, western wheatgrass, and green needlegrass. No major hazards or limitations affect the use of this soil for range. Grazing management that maintains an adequate cover of the key plants helps to control erosion during periods of flooding.

This soil generally is unsuited to dwellings and septic tank absorption fields because of the flooding. Soils that are better suited to these uses generally are nearby.

The land capability classification is VIw. The productivity index for spring wheat is 0. The range site is Overflow.

31B—Watrous loam, 1 to 6 percent slopes. This moderately deep, nearly level and gently sloping, well drained soil is on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes are plane, moderately long, and smooth. Individual areas range from about 10 to 300 acres.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is about 21 inches thick. It is brown. It is clay loam in the upper part and channery clay loam in the lower part. White, hard bedrock is at a depth of about 27 inches. In some places the surface layer is silt loam, clay loam, or fine sandy loam. In other places the soil is dark to a depth of more than 16 inches.

Included with this soil in mapping are small areas of Cabba, Daglum, Heil, and Sinnigam soils. Cabba soils have a light colored surface layer and have soft bedrock at a depth of 10 to 20 inches. Daglum soils have a dense, alkali subsoil. Heil soils are poorly drained and are in depressions. Sinnigam soils have hard bedrock within a depth of 20 inches. Also included are some very stony areas and a few areas where bedrock is at a depth of 40 to 60 inches. Included soils make up 5 to 20 percent of the unit.

Permeability, available water capacity, and organic matter content are moderate in the Watrous soil. Runoff is slow. The rooting depth is restricted by the bedrock at a depth of about 27 inches. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops or hay. Some are used as range. This soil is suited to small grain and to grasses and legumes. Water erosion is the main management concern. It can be controlled by a system of conservation tillage that leaves crop residue on the surface, stripcropping, grassed waterways in areas where runoff concentrates, and a cropping sequence that includes grasses and legumes. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Cover crops, conservation tillage, and a cover of grasses and legumes help to maintain or increase the organic matter content, increase the rate of water infiltration, and conserve moisture.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and needleandthread. Crested wheatgrass, intermediate wheatgrass, slender wheatgrass, western wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings without basements, but it generally is unsuited to dwellings with basements and to septic tank absorption fields because of the depth to hard bedrock. The moderate shrink-swell potential is a limitation on sites for dwellings without basements, but installing surface and foundation drains and reinforcing foundations help to prevent the structural damage caused by shrinking and swelling. Soils that are better suited to septic tank absorption fields and dwellings with basements generally are nearby.

The land capability classification is IIe. The productivity index for spring wheat is 54. The range site is Silty.

32—Dumps-Pits complex. This map unit consists of steep mine-spoil dumps and nearly level open pits. It is in areas where soil material and overburden have been removed and the underlying lignite, gravel, or scoria (porcelanite) has been mined. The soil material and overburden have been mixed in the mining process. Generally, the pits are ponded during part of the year. Individual areas range from about 10 to 75 acres in size. The dumps and pits occur as areas so intricately mixed or so small that mapping them separately is not practical.

Most areas have been abandoned and are not used for any purpose, but a few are used as sites for landfills. Unless reclaimed, this unit generally is unsuited to most uses, except for wildlife habitat. Some grasses, trees, shrubs, and weeds have become established, but plant density is low. Some wildlife use the unit as a site for nesting or feeding or for protection from predators. Onsite investigation is needed when specific uses of this unit are planned and designed.

No land capability classification or range site is assigned. The productivity index for spring wheat is 0.

33B—Savage clay loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on toe slopes in the uplands. Most areas are crossed by shallow drainageways, but in places drainageways are entrenched. Slopes generally are plane, long, and smooth. Individual areas range from about 10 to 300 acres.

Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The subsoil is about 30 inches thick. It is dark grayish brown clay in the upper part, grayish brown clay in the next part, and light yellowish brown clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray and light yellowish brown clay loam. In places the soil is dark to a depth of more than 16 inches. In a few areas the surface layer is silty clay loam. In some areas the substratum is silty clay or clay.

Included with this soil in mapping are small areas of Daglum and Moreau soils. Daglum soils have a dense, alkali subsoil or substratum. They are in swales. Moreau soils have soft shale at a depth of 20 to 40 inches and have a surface layer that is lighter colored than that of the Savage soil. They are on side slopes. Also included are some areas where bedrock is at a depth of 40 to 60 inches. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Savage soil. Available water capacity is high, and organic matter content is moderate. Runoff is medium. Tilth is fair. Because of the high clay content, the surface layer is best tilled when the soil is neither too wet nor too dry. It tends to form clods when dry and puddle when wet.

Most areas are used for cultivated crops. Some are used as hayland, pasture, or range. This soil is well suited to small grain and to grasses and legumes. Because of the long slopes, the major management concern is the hazard of water erosion. This hazard can be reduced by diversions, grassed waterways in areas where runoff concentrates, a system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and a cropping sequence that includes grasses and legumes. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage and a cover of grasses and legumes help to maintain or increase the organic matter content and improve water infiltration.

This soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are western wheatgrass and green needlegrass. Crested wheatgrass, hard fescue, green needlegrass, slender wheatgrass, alfalfa, and sweetclover are suitable pasture and hay plants. Water erosion is a problem in overgrazed pastures. It can be controlled by grazing management that maintains an adequate cover of the key plants. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

This soil is suited to dwellings and septic tank absorption fields. A high shrink-swell potential is a limitation on sites for dwellings, but installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling. The slow absorption of liquid waste is a limitation in septic tank absorption fields, but it can be overcome by enlarging the absorption field or by installing a mound system.

The land capability classification is IIe. The productivity index for spring wheat is 72. The range site is Clayey.

34F—Cabba-Brandenburg-Savage complex, 6 to 70 percent slopes. These soils are on uplands that generally are crossed by moderately deep drainageways. Slumping and slippage occur in most areas. The hilltops generally are very stony. The stones consist of pseudoquartzite and clinkers from burned-out coal veins.

The shallow, well drained, moderately sloping to very steep Cabba soil has convex, short, uneven slopes. It is on the upper side slopes and on the summits of hills adjacent to the Brandenburg soils. The excessively drained, moderately sloping to very steep Brandenburg soil has convex, short, uneven slopes. It is on the top of ridges and cone-shaped hills. It is shallow to porcelanite (scoria). The deep, well drained, moderately sloping and strongly sloping Savage soil has concave, short, smooth slopes. It is in small valleys and swales between the hills and on the lower side slopes. Individual areas range from about 5 to 200 acres. They are about 40 to 45 percent Cabba soil, 25 to 35 percent Brandenburg soil, and 10 to 25 percent Savage soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabba soil has a surface layer of light brownish gray loam about 4 inches thick. The subsoil is light yellowish brown loam about 9 inches thick. The substratum is pale olive loam about 4 inches thick. Pale olive, soft bedrock is at a depth of about 17 inches. In places the surface layer and substratum are silt loam, fine sandy loam, silty clay loam, or silty clay. In a few areas the soil is dark to a depth of 6 to 10 inches.

Typically, the Brandenburg soil has a surface layer of reddish brown channery sandy loam about 5 inches thick. The upper part of the substratum is dark reddish brown very channery sandy loam. The lower part to a depth of about 60 inches is light red, shattered porcelanite (scoria). In some places the depth to porcelanite is more than 20 inches. In other places the surface layer is gravelly sandy loam or gravelly loam. In a few areas the soil is dark to a depth of 5 to 10 inches.

Typically, the Savage soil has a surface layer of dark grayish brown clay loam about 6 inches thick. The subsoil is about 30 inches thick. It is dark grayish brown clay in the upper part, grayish brown clay in the next part, and light yellowish brown clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray and light yellowish brown clay loam. In places the soil is dark to a depth of more than 16 inches. In a few areas the surface layer is loam, silt loam, or silty clay loam.

Included with these soils in mapping are small areas of Amor and Chama soils on side slopes and Daglum soils in swales. Amor and Chama soils have soft bedrock at a depth of 20 to 40 inches and have a dark surface layer. Daglum soils have a dense, alkali subsoil. Also included are small areas of shale outcrop and a few areas where bedrock is at a depth of 40 to 60 inches. Included areas make up 5 to 20 percent of the unit.

Permeability is moderate in the Cabba soil and slow in the Savage soil. It is moderate in the upper part of the Brandenburg soil and very rapid in the lower part. Available water capacity is very low in the Brandenburg and Cabba soils and high in the Savage soil. Organic matter content is low in the Cabba and Brandenburg soils and moderate in the Savage soil. Runoff is rapid in all three soils. The rooting depth is restricted by the bedrock at a depth of about 17 inches in the Cabba soil and by the porcelanite at a depth of about 18 inches in the Brandenburg soil.

Most areas are used as range. The lower slopes in some areas are used for cultivated crops. Some areas of the Brandenburg soil have been mined for porcelanite. Because of the slope and droughtiness of the Cabba and Brandenburg soils, this unit is generally unsuited to cultivated crops. It is best suited to range. A cover of range plants is effective in controlling erosion. The key range plants are western wheatgrass, needleandthread, little bluestem, prairie sandreed, and blue grama. Soil blowing, water erosion, and the very low available water capacity of the Cabba and Brandenburg soils are problems in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. The slope limits the use of machinery. Grazing management that maintains an adequate cover of the key plants at a height that traps snow helps to store water in the soil, control soil blowing and water erosion, and prevent denuding. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

The Savage soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Brandenburg and Cabba soils are generally unsuited. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

These soils are poorly suited to dwellings and generally unsuited to septic tank absorption fields. The slope is a limitation on sites for dwellings, but it can be overcome by designing the buildings so that they conform to the natural slope of the land. The depth to bedrock in the Cabba soil and a high shrink-swell potential in the Savage soil also are limitations. The rock is soft and can be easily excavated. Installing surface and foundation drains and reinforcing basement and foundation walls help to prevent the structural damage caused by shrinking and swelling.

The Savage soil is better suited to septic tank absorption fields than the Cabba and Brandenburg soils. The slow absorption of liquid waste, however, is a limitation. It can be overcome by enlarging the absorption field or by installing a mound system. The effluent from septic tank systems in the Brandenburg and Cabba soils can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. As a result, alternative sites or disposal systems should be considered.

The land capability classification assigned to the Cabba soil is VIIe, that assigned to the Brandenburg soil is VIIs, and that assigned to the Savage soil is IVe. The productivity index for spring wheat is 0. The Cabba soil is assigned to the Shallow range site, the Brandenburg soil to the Very Shallow range site, and the Savage soil to the Clayey range site.

35F—Cabba-Amor-Savage complex, 9 to 70 percent slopes. These well drained soils are on uplands that generally are crossed by moderately deep drainageways. Slumping and slippage occur in most areas. About 10 to 40 percent of the surface of the Cabba and Amor soils is covered with stones and boulders, which generally are about 2 feet in diameter but range from less than 10 inches to more than 5 feet. Only a few stones are on the surface of the Savage soil.

The shallow, strongly sloping to very steep Cabba soil has convex, short, uneven slopes. It is on knobs, ridges, and buttes. The moderately deep, strongly sloping and moderately steep Amor soil has convex, short, smooth slopes. It is on side slopes. The deep, strongly sloping Savage soil has concave, moderately long, smooth slopes. It is on side slopes and in swales between knobs, ridges, and buttes. Individual areas range from about 10 to 600 acres. They are about 35 to 65 percent Cabba soil, 15 to 30 percent Amor soil, and 15 to 30 percent Savage soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Cabba soil has a surface layer of grayish brown, calcareous extremely stony loam about 4 inches thick. The substratum is loam about 13 inches thick. It is pale yellow in the upper part and light brownish gray in the lower part. Pale olive, soft bedrock is at a depth of about 17 inches. In some places the surface layer and substratum are fine sandy loam, silt loam, or silty clay. In other places the surface layer is dark grayish brown. In a few areas the bedrock is hard.

Typically, the Amor soil has a surface layer of dark grayish brown extremely stony loam about 8 inches thick. The subsoil is loam about 28 inches thick. It is brown in the upper part, light brownish gray in the next part, and light gray in the lower part. Light gray and pale yellow, soft bedrock is at a depth of about 36 inches. In some places the depth to soft bedrock is more than 40 inches. In other places the surface layer and subsoil are clay loam, fine sandy loam, or silt loam. In some areas the subsoil and substratum have rock fragments as much as 15 inches in diameter.

Typically, the Savage soil has a surface layer of dark grayish brown clay loam about 6 inches thick. The subsoil is about 30 inches thick. It is dark grayish brown clay in the upper part, grayish brown clay in the next part, and light yellowish brown clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray and light yellowish brown clay loam. In places the soil is dark to a depth of more than 16 inches. In a few areas the subsoil and substratum have rock fragments as much as 15 inches in diameter.

Included with these soils in mapping are small areas of Daglum soils in swales and Moreau soils on side slopes. Daglum soils are deep and have a dense, alkali subsoil. Moreau soils are clayey throughout and have shale bedrock at a depth of 20 to 40 inches. Also included are some areas where bedrock is at a depth of 40 to 60 inches. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Cabba and Amor soils and slow in the Savage soil. Available water capacity is very low in the Cabba soil, moderate in the Amor soil, and high in the Savage soil. Organic matter content is low in the Cabba soil and moderate in the Amor and Savage soils. Runoff is rapid on all three soils. The rooting depth is restricted by the bedrock at a depth of about 17 inches in the Cabba soil and 36 inches in the Amor soil.

Most areas are used as range. Some small areas of the Savage soil are used for cultivated crops or hay. Because of the stoniness and slope of the Cabba and Amor soils, this unit is generally unsuited to small grain, trees, and shrubs. It is best suited to range. A cover of range plants is effective in protecting the soils. The key range plants are western wheatgrass, needleandthread, little bluestem, and green needlegrass. Water erosion and the very low available water capacity of the Cabba soil are problems in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. The slope limits the use of machinery. Grazing management that maintains an adequate cover of the key plants at a height that traps snow helps to store water in the soil, control water erosion, and prevent denuding. Gullies can form along cattle trails. Cross fences and a planned grazing system help to prevent gullying and improve gullied areas.

The Savage soil is suited to nearly all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings, but the Cabba and Amor soils are generally unsuited. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings.

These soils are poorly suited to dwellings and generally unsuited to septic tank absorption fields. The slope is a limitation on sites for dwellings, but it can be overcome by designing the buildings so that they conform to the natural slope of the land. The depth to bedrock in the Cabba and Amor soils and a high shrink-swell potential in the Savage soil also are limitations. The rock is soft and can be easily excavated. Installing surface and foundation drains and reinforcing foundations and basement walls help to prevent the structural damage caused by shrinking and swelling.

The Savage soil is better suited to septic tank absorption fields than the Cabba and Amor soils. The slow absorption of liquid wastes, however, is a limitation. It can be overcome by enlarging the absorption field or by installing a mound system. The effluent from septic tank systems in the Cabba and Amor soils can seep along bedding planes in the bedrock and surface downslope or contaminate water supplies. As a result, alternative sites or disposal methods should be considered.

The land capability classification assigned to the Cabba and Amor soils is VIIs, and that assigned to the Savage soil is IVe. The productivity index for spring wheat is 0. The Cabba soil is assigned to the Shallow range site, the Amor soil to the Silty range site, and the Savage soil to the Clayey range site.

36—Velva fine sandy loam. This deep, level, well drained soil is on flood plains. It generally is occasionally flooded but in some areas is only rarely flooded. Most areas have an indistinct drainage pattern that generally parallels the stream channels. Abandoned stream channels are in some areas. Slopes are long and smooth. They generally are plane, but some are convex. Individual areas range from about 20 to 600 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 4 inches thick. The substratum extends to a depth of 60 inches or more. In sequence downward, it is dark grayish brown fine sandy loam, grayish brown fine sandy loam stratified with loam, very dark gray fine sandy loam, and grayish brown fine sandy loam stratified with loam and loamy fine sand. In some places the surface layer is loam. In other places the soil contains less sand and more clay. In a few areas the surface layer is lighter colored.

Included with this soil in mapping are small areas of Straw soils on the slightly concave parts of the landscape and Dimmick soils in abandoned stream channels. Both of these soils are dark to a greater depth than the Velva soil. Also, Straw soils have more clay. Dimmick soils are very poorly drained and are clayey. Also included, adjacent to streams, is a soil that is loamy fine sand or fine sand throughout. This soil has a surface layer that is lighter colored than that of the Velva soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Velva soil. Available water capacity and organic matter content are high. Runoff is slow. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used as range. Some are used for cultivated crops, hay, or pasture. This soil is suited to small grain and to grasses and legumes. The major management concerns are a severe hazard of soil blowing and the flooding hazard. The flooding generally occurs after snowmelt and before the crops are planted. A system of conservation tillage that leaves crop residue on the surface, buffer strips, stripcropping, windbreaks, and a cropping sequence that includes grasses and legumes help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain the organic matter content and improve water infiltration. They also increase the moisture supply by trapping snow.

This soil is suited to all of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. No critical limitations affect survival or growth. Removing grasses and weeds before the trees and shrubs are planted and controlling regrowth of the competing vegetation increase the survival and growth rates of the seedlings. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of range or pasture plants is effective in controlling erosion. The key range plants are needleandthread and prairie sandreed. Altari wildrye, intermediate wheatgrass, prairie sandreed, smooth bromegrass, green needlegrass, alfalfa, and sweetclover are suitable pasture and hay plants. No major hazards or limitations affect the use of this soil for range or pasture. Grazing management that maintains an adequate cover of the key plants helps to protect the soil.

This soil generally is unsuited to dwellings and septic tank absorption fields because of the flooding. Soils that are better suited to these uses are generally nearby.

The land capability classification is IIIe. The productivity index for spring wheat is 70. The range site is Sandy.

37B—Ekalaka fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained, alkali soil is on uplands. Most areas are crossed by shallow drainageways. Slopes are convex, short, and smooth. Individual areas range from about 10 to 325 acres.

Typically, the surface soil is fine sandy loam about 12 inches thick. It is dark grayish brown in the upper part and brown in the lower part. The subsurface layer is light brownish gray loamy fine sand about 5 inches thick. The subsoil is about 28 inches thick. It is grayish brown fine sandy loam in the upper part and light yellowish brown loam in the lower part. Grayish brown and light gray, soft bedrock is at a depth of about 45 inches. In some places the surface layer is loam. In other places the subsoil is sandy clay loam. In a few areas the depth to the subsoil is 20 to 40 inches.

Included with this soil in mapping are small areas of Parshall, Daglum, and Vebar soils. Parshall soils are dark to a depth of more than 16 inches. They are in swales. Daglum soils also are in swales. They have a dense, alkali subsoil. Vebar soils have soft sandstone at a depth of 20 to 40 inches. They are on side slopes. Also included are some areas of nonalkali soils that have a layer of accumulated clay in the subsoil. Included soils make up 5 to 20 percent of the unit.

Permeability is slow in the Ekalaka soil. Available water capacity is low, and organic matter content is moderately low. Runoff is slow. The rooting depth is restricted by the dense, alkali subsoil at a depth of about 17 inches. Tilth is good. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. Some are used as hayland, pasture, or range. This soil is poorly suited to small grain because of the alkali subsoil, droughtiness, and a severe hazard of soil blowing. The main management concerns are controlling soil blowing and conserving moisture. A system of conservation tillage that leaves crop residue on the surface, buffer strips, windbreaks, stripcropping, and a cropping sequence that includes grasses and legumes help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain or increase the organic matter content and improve water infiltration. They also increase the moisture supply by trapping snow.

This soil is suited to only a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Only the drought- and salt-tolerant species are suitable. Irrigation and control of the ground cover help to ensure survival of the seedlings. The trees and shrubs vary in height, density, and vigor, however, because of the restricted root development in the dense subsoil and the reduced available water capacity caused by the salts in the soil. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plants are needleandthread, western wheatgrass, and blue grama. Crested wheatgrass, intermediate wheatgrass, slender wheatgrass, and sweetclover are suitable pasture and hay plants. The restricted rooting depth is a problem in overgrazed pastures. Vegetation is difficult to reestablish in denuded areas. Grazing management that maintains an adequate cover of the key plants helps to control soil blowing.

This soil is suited to dwellings and septic tank absorption fields. At the depth that the distribution lines generally are installed, the soil readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity may result in the pollution of ground water. It can be overcome by a mound system. The sides of shallow excavations, such as those for basement walls, tend to cave in unless they are shored.

The land capability classification is IVe. The productivity index for spring wheat is 41. The range site is Sandy Claypan.

41—Grail clay loam, saline, 1 to 3 percent slopes. This deep, nearly level, well drained, moderately saline soil is in swales on uplands. Most areas are crossed by shallow drainageways. Slopes generally are concave, long, and smooth. Individual areas range from about 10 to more than 40 acres.

Typically, the surface layer is very dark grayish brown clay loam about 9 inches thick. It contains salt flecks. The subsoil is about 18 inches thick. It is very dark grayish brown clay in the upper part, dark grayish brown clay in the next part, and grayish brown clay loam in the lower part. The next layer is light brownish gray clay loam about 9 inches thick. The upper part of the substratum is grayish brown sandy clay loam. The lower part to a depth of about 60 inches is grayish brown silty clay loam. In some areas the surface layer is silty clay loam or silt loam. In a few areas it is light colored. In some places the subsoil is silty clay loam. In other places the soil is nonsaline or strongly saline.

Included with this soil in mapping are small areas of Daglum and Rhoades soils. These soils are in microdepressions. They have a dense, alkali subsoil. They make up 5 to 15 percent of the unit.

Permeability is slow in the Grail soil. Available water capacity is moderate, and organic matter content is high. Runoff is slow. The soil receives runoff from the adjacent areas. Tilth is fair. The surface layer is best tilled when the soil is neither too wet nor too dry. The salt content restricts plant growth. A seasonal high water table is at a depth of 4 to 6 feet.

Most areas are used for cultivated crops. Some are used as range or hayland. This soil is poorly suited to small grain and to grasses and legumes. In years when the amount of precipitation is above average, seeding is delayed and occasionally prevented. The main management concerns are the salinity and the occasional wetness in drainageways. They can be minimized by maintaining a continuous cover of crops or growing deep rooted crops. A system of conservation tillage that leaves crop residue on the surface, stripcropping, and cover crops help to control erosion. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage and cover crops help to maintain fertility, increase the rate of water infiltration, maintain the organic matter content, and trap snow, which helps to leach salts from the surface layer during snowmelt.

This soil is suited to only a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Only the most salt tolerant species are suitable. The trees and shrubs vary in height, density, and vigor because of the reduced available water capacity caused by the salts in the soil. Reduction of the evaporation rate at the surface increases the seedling survival rate. If the soil is bare as it dries, salt-laden water tends to move to the surface.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plant is western wheatgrass. Altari wildrye, tall wheatgrass, alkali sacaton, beardless wildrye, western wheatgrass, and sweetclover are suitable pasture and hay plants. The high content of salts, the limited available water capacity, compaction, trampling, and root damage are problems, especially if the range is grazed when the soil is wet. Grazing management that maintains the key salt-tolerant species helps to control erosion. Stock water ponds constructed in this soil frequently contain salty water.

This soil is poorly suited to dwellings and septic tank absorption fields. In this survey area, it generally is not used for these purposes. Better sites are nearby.

The land capability classification is IIIs. The productivity index for spring wheat is 45. The range site is Saline Lowland.

51—Parshall fine sandy loam, saline, 1 to 3 percent slopes. This deep, nearly level, well drained, moderately saline soil is in swales on uplands. Most areas are crossed by shallow drainageways, but in some areas drainageways are indistinct. Slopes generally are concave, moderately long, and smooth. Individual areas range from about 10 to more than 100 acres.

Typically, the surface soil is dark grayish brown fine sandy loam about 10 inches thick. It contains salt flecks. The subsoil is fine sandy loam about 25 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown fine sandy loam. In some places the surface layer is loam or sandy loam. In other places the substratum is gravelly loam below a depth of 35 inches. In a few places the surface layer and subsoil are loam or loamy fine sand. In some areas the soil is nonsaline or strongly saline.

Included with this soil in mapping are small areas of Bowdle and Vebar soils. Bowdle soils have sand and gravel at a depth of 20 to 40 inches. They are on slight rises. Vebar soils have soft sandstone at a depth of 20 to 40 inches. They are on side slopes. Included soils make up 5 to 20 percent of the unit.

Permeability is moderately rapid in the Parshall soil. Available water capacity is low, and organic matter content is moderate. Runoff is slow. The soil generally receives runoff from the adjacent areas. Tilth is good. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. The salt content restricts plant growth. A seasonal high water table is at a depth of 4 to 6 feet.

Most areas are used for cultivated crops, hay, or pasture. A few are used as range. This soil is poorly suited to small grain. In years when the amount of precipitation is above average, seeding is delayed and occasionally prevented. The major management concerns are the salinity, occasional wetness, and soil blowing. A continuous cover of crops or selection of deep rooted crops for planting helps to minimize the occasional wetness and the salinity. Windbreaks, buffer strips, a system of conservation tillage that leaves crop residue on the surface, stripcropping, cover crops, and a cropping sequence that includes grasses and legumes help to control soil blowing. Conservation tillage also helps to provide food and cover for resident and migratory wildlife. Conservation tillage, cover crops, and a cover of grasses and legumes help to maintain the organic matter content, improve water infiltration, and trap snow, which helps to leach salts from the surface layer during snowmelt.

This soil is suited to only a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Only the most salt tolerant species are suitable. The trees and shrubs vary in height, density, and vigor because of the reduced available water capacity caused by the salts in the soil. Reduction of the evaporation rate at the surface increases the seedling survival rate. If the soil is bare as it dries, salt-laden water tends to move to the surface. Strips of an annual cover crop between the rows help to control soil blowing and protect the seedlings from abrasion.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plant is western wheatgrass. Altai wildrye, tall wheatgrass, alkali sacaton, beardless wildrye, western wheatgrass, and sweetclover are suitable pasture and hay plants. The high content of salts, the limited available water capacity, compaction, trampling, and root damage are problems, especially if the range is grazed when the soil is wet. Grazing management that maintains the key salt-tolerant species helps to control erosion. Stock water ponds constructed in this soil frequently contain salty water.

This soil is poorly suited to dwellings and septic tank absorption fields. In this survey area, it generally is not used for these purposes. Better sites are nearby.

The land capability classification is IIIs. The productivity index for spring wheat is 35. The range site is Saline Lowland.

61—Arnegard loam, saline, 1 to 3 percent slopes. This deep, nearly level, well drained, moderately saline soil is in swales on uplands. Most areas are crossed by shallow drainageways. In some areas the drainageways fan out and are indistinct. Slopes generally are concave, moderately long, and smooth. Individual areas range from about 10 to more than 40 acres.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. It contains salt flecks. The subsoil is loam about 22 inches thick. It is dark grayish brown in the upper part, brown in the next part, and light brownish gray in the lower part. The substratum to a depth of about 60 inches is light yellowish brown fine sandy loam. In places the soil is dark to a depth of 15 inches or less. In a few areas the substratum is mottled. In a few places the surface layer is silt loam or fine sandy loam. In some areas the subsoil is clay loam or fine sandy loam. In other areas the soil is nonsaline or strongly saline.

Included with this soil in mapping are small areas of Amor, Belfield, Grail, and Vebar soils. Amor and Vebar soils are dark to a depth of less than 16 inches and have soft bedrock at a depth of 20 to 40 inches. They are on side slopes. Belfield and Grail soils have more clay in the subsoil than the Arnegard soil. They are in swales. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate in the Arnegard soil. Available water capacity is moderate, and organic matter content is high. Runoff is slow. The soil generally receives runoff from the adjacent areas. Tilth is good. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. The salt content restricts plant growth. A seasonal high water table is at a depth of 4 to 6 feet.

Most areas are used for cultivated crops, hay, or pasture. Some are used as range. This soil is poorly suited to small grain, grasses, and legumes. In years when the amount of precipitation is above average, seeding is delayed and occasionally prevented. The major management concerns are the salinity and occasional wetness. They can be minimized by a continuous cover of crops or selection of deep rooted crops for planting. A system of conservation tillage that leaves crop residue on the surface and a cropping sequence that includes grasses and legumes help to maintain tilth and fertility. They also help maintain the organic matter content, improve infiltration, and trap snow, which leaches salts from the surface layer during snowmelt. Conservation tillage helps to provide food and cover for resident and migratory wildlife.

This soil is suited to only a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Only the most salt tolerant species are suitable. The trees and shrubs vary in height, density, and vigor because of the reduced available water capacity caused by the salts in the soil. Reduction of the evaporation rate at the surface increases the seedling survival rate. If the soil is bare as it dries, salt-laden water tends to move to the surface.

A cover of hay or of pasture or range plants is effective in controlling erosion. The key range plant is western wheatgrass. Altari wildrye, tall wheatgrass, alkali sacaton, beardless wildrye, western wheatgrass, and sweetclover are suitable pasture and hay plants. The high content of salts, the limited available water capacity, compaction, trampling, and root damage are problems, especially if the range is grazed when the soil is wet. Grazing management that maintains the key salt-tolerant species helps to control erosion. Stock water ponds constructed in this soil frequently contain salty water.

This soil is poorly suited to dwellings and septic tank absorption fields. In this survey area, it generally is not used for these purposes. Better sites are nearby.

The land capability classification is IIIs. The productivity index for spring wheat is 49. The range site is Saline Lowland.

81—Belfield-Savage-Daglum silt loams, saline, 1 to 3 percent slopes. These nearly level, moderately saline soils are on uplands. Most areas are crossed by shallow drainageways, but in places drainageways are indistinct. In cultivated areas slopes generally are concave, moderately long, and smooth. In areas of native grass, they are moderately long. The surface has a characteristic microrelief. Generally, the well drained, alkali Belfield soil and the well drained, nonalkali Savage soil are on small mounds, and the well drained and moderately well drained, alkali Daglum soil is in microdepressions. Individual areas range from about 10 to more than 150 acres. They are about 30 to 45 percent Belfield soil, 30 to 45 percent Savage soil, and 10 to 40 percent Daglum soil. The three soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Belfield soil has a surface layer of grayish brown silt loam about 9 inches thick. It contains salt flecks. The next layer is grayish brown silty clay loam about 3 inches thick. It has light gray coatings. The subsoil is about 21 inches thick. The upper part is grayish brown silty clay, and the lower part is light brownish gray silty clay loam. The substratum to a depth of about 60 inches is grayish brown and light brownish gray silty clay loam. In some places the surface layer is loam, clay loam, or silty clay loam. In other places the substratum is stratified with loam or sandy loam. In some areas the soil is nonsaline or strongly saline.

Typically, the Savage soil has a surface layer of dark grayish brown silt loam about 6 inches thick. The subsoil is about 30 inches thick. It is dark grayish brown clay in the upper part, grayish brown clay in the next part, and light yellowish brown clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray and light yellowish brown clay loam. In places the surface layer is clay loam.

Typically, the Daglum soil has a surface layer of dark grayish brown silt loam about 7 inches thick. It has a salt crust or contains salt flecks. The subsurface layer is grayish brown silt loam about 1 inch thick. The subsoil is about 24 inches thick. It is dark grayish brown clay in the upper part and grayish brown clay loam in the lower part. The upper part of the substratum is grayish brown clay loam. The lower part to a depth of about 60 inches is light yellowish brown clay. In some places the surface layer is loam, clay loam, or silty clay loam. In other places it is lighter colored and has been mixed with the subsoil by cultivation. In a few areas the substratum is stratified with loam or fine sandy loam. In some areas the soil is nonsaline or strongly saline.

Included with these soils in mapping are small areas of Grail and Rhoades soils in swales. Grail soils are dark to a depth of more than 16 inches. Rhoades soils have a dense, alkali subsoil at a depth of 5 inches. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Belfield and Savage soils and very slow in the Daglum soil. Available water capacity is moderate in the Belfield and Savage soils and low in the Daglum soil. Organic matter content is moderate in all three soils. Runoff is slow. The rooting depth is restricted by the dense, alkali subsoil in the Belfield and Daglum soils. Tilth is good. The surface layer is friable and generally can be easily tilled throughout a wide range in moisture content. The salt content restricts plant growth. A seasonal high water table is at 4 to 6 feet.

Most areas are used for cultivated crops. Some are used as range. These soils are poorly suited to small grain, tame grasses, and legumes. In years when the amount of precipitation is above average, seeding is sometimes delayed or prevented. The major management concerns are the salinity and occasional wetness. A system of conservation tillage that leaves crop residue on the surface and a cropping sequence that includes grasses and legumes help to maintain tilth and fertility. A continuous cover of crops and inclusion of deep rooted plants, such as legumes, in the crop rotation help to loosen the dense subsoil and minimize the occasional wetness and the salinity. Conservation tillage and a cover of grasses and legumes help to maintain or increase the organic matter content, improve infiltration, and trap snow, which helps to leach salts from the surface layer during snowmelt. Conservation tillage also helps to provide food and cover for migratory and resident wildlife.

These soils are suited to a few of the climatically adapted trees and shrubs grown as windbreaks and environmental plantings. Only the most salt tolerant species are suitable. The trees and shrubs vary in height, density, and vigor because of the reduced available water capacity caused by the salts in the soil. Reduction of the evaporation rate at the surface increases the seedling survival rate. If the soil is bare as it dries, salt-laden water tends to move to the surface.

A cover of hay or of pasture or range plants is effective in protecting these soils. The key range plant is western wheatgrass. Altari wildrye, tall wheatgrass, alkali sacaton, beardless wildrye, western wheatgrass, and sweetclover are suitable pasture and hay plants. The high content of salts, the limited available water capacity, compaction, trampling, and root damage are problems, especially if the range is grazed when the soil is wet. Grazing management that maintains the key salt-tolerant species helps to control erosion. Stock water ponds constructed in these soils frequently contain salty water.

These soils are poorly suited to dwellings and septic tank absorption fields. In this survey area, they generally are not used for these purposes. Better sites are nearby.

The land capability classification assigned to the Belfield and Savage soils is IIIs, and that assigned to the the Daglum soil is IVs. The productivity index for spring wheat is 34. All three soils are assigned to the Saline Lowland range site.

Prime Farmland

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

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

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

About 29,120 acres in the survey area, or less than 5 percent of the total acreage, meets the soil requirements for prime farmland. Nearly all of this prime farmland is used for crops. The principal crops grown on this land are wheat and sunflowers.

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

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

15 Arnegard loam, 1 to 3 percent slopes
4 Grail clay loam, 1 to 3 percent slopes
24 Straw loam, 0 to 3 percent slopes

Use and Management of the Soils

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

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

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

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

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

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

Crops

This section was prepared by Lyle J. Samson, agronomist, and Lawrence J. Luger, soil conservationist, Soil Conservation Service.

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

In 1981, about 157,300 acres in Adams County was used for close-grown crops, mainly wheat, barley, oats, and rye. During the period 1977 to 1981, the acreage used for close-grown crops averaged about 134,400 acres. Other crops grown in 1981 were sunflowers, on 7,500 acres; corn, on 10,400 acres; flax, on 500 acres; and hay, on 60,000 acres. About 115,000 acres was summer fallowed. The acreage of summer fallow fluctuates from year to year. It was 142,000 in 1980 and 124,000 in 1979. About 83 percent of the wheat was planted on fallow land in 1981 (*9*).

The potential of the soils in Adams County for increased production of food and fiber is good. This production could be increased by extending the latest crop production technology to all cropland in the county. This soil survey can facilitate the application of such technology.

The soils and climate of the county are suited to most of the crops that are commonly grown in the survey area, including wheat, barley, oats, sunflowers, corn for silage, flax, rye, legumes, and tame grasses. Crops that are not commonly grown but are suitable include potatoes, mustard, safflower, buckwheat, and dry edible beans, such as pinto beans.

The main management measures that help to ensure continuing productivity are those that control soil blowing and water erosion, conserve moisture, control saline seeps, and maintain fertility.

Soil blowing is a hazard on nearly all of the soils in Adams County. It is most severe on the moderately coarse textured and coarse textured Beisigl, Ekalaka, Flasher, Lihen, Parshall, Ruso, Vebar, and Velva soils. Soil blowing can damage these soils in a very short time if they are farmed in large blocks or wide fields and if winds are strong and the soils are dry and bare of vegetation or surface mulch. The soils that are moderately susceptible to soil blowing include the fine textured Lawther, Moreau, and Wayden soils and the medium textured and moderately fine textured Chama and Cabba soils, which have a high content of lime in the surface layer.

Water erosion is a hazard mainly on the gently sloping and steeper soils. The principal soils that are subject to water erosion are Amor, Cabba, Chama, Moreau, Regent, Vebar, and Wayden soils.

Among the measures that help to control soil blowing and water erosion are keeping crop residue on the surface; growing cover crops; stripcropping; planting buffer strips; establishing windbreaks; tilling on the contour; constructing diversions, terraces, and grassed waterways (fig. 11); keeping tillage to a minimum; using timely and emergency tillage; growing grasses and legumes in the cropping sequence; and managing crop residue (fig. 12). A combination of several measures generally is needed.

Moisture generally is conserved by measures that reduce evaporation and runoff rates, increase the rate of water infiltration, and control weeds. Examples are stubble mulching, contour tillage, stripcropping, field windbreaks, buffer strips, timely and minimum tillage, inclusion of grasses and legumes in the cropping sequence, a cover of crop residue, and applications of fertilizer. Periods of fallow help to control weeds and to store available moisture in the soil.

Among the measures that help to maintain fertility are applying fertilizer, plowing green manure and barnyard manure under, and including cover crops, grasses, and legumes in the cropping sequence. Most practices that help to control soil blowing and water erosion also help to maintain fertility.

Some common conservation practices, such as incorporating green manure crops into the soil and including grasses and legumes in the cropping sequence, help to maintain good tilth. Plowing heavy textured soils, such as Lawther silty clay, at the right moisture content in the fall helps to maintain tilth and prepare a good seedbed. Fall plowing, however, increases the risk of soil blowing in the spring.

Management of Saline and Sodium Affected Soils

Saline and alkali soils make up about 25 percent of Adams County. Saline soils make up 1.5 percent of the county, or about 10,000 acres; alkali soils make up 20 percent, or about 125,500 acres; and saline-alkali soils make up 4 percent, or about 26,500 acres. Saline seeps affect about 12,000 acres, or 2 percent in the county. Arnegard loam, saline; Grail clay loam, saline; Parshall

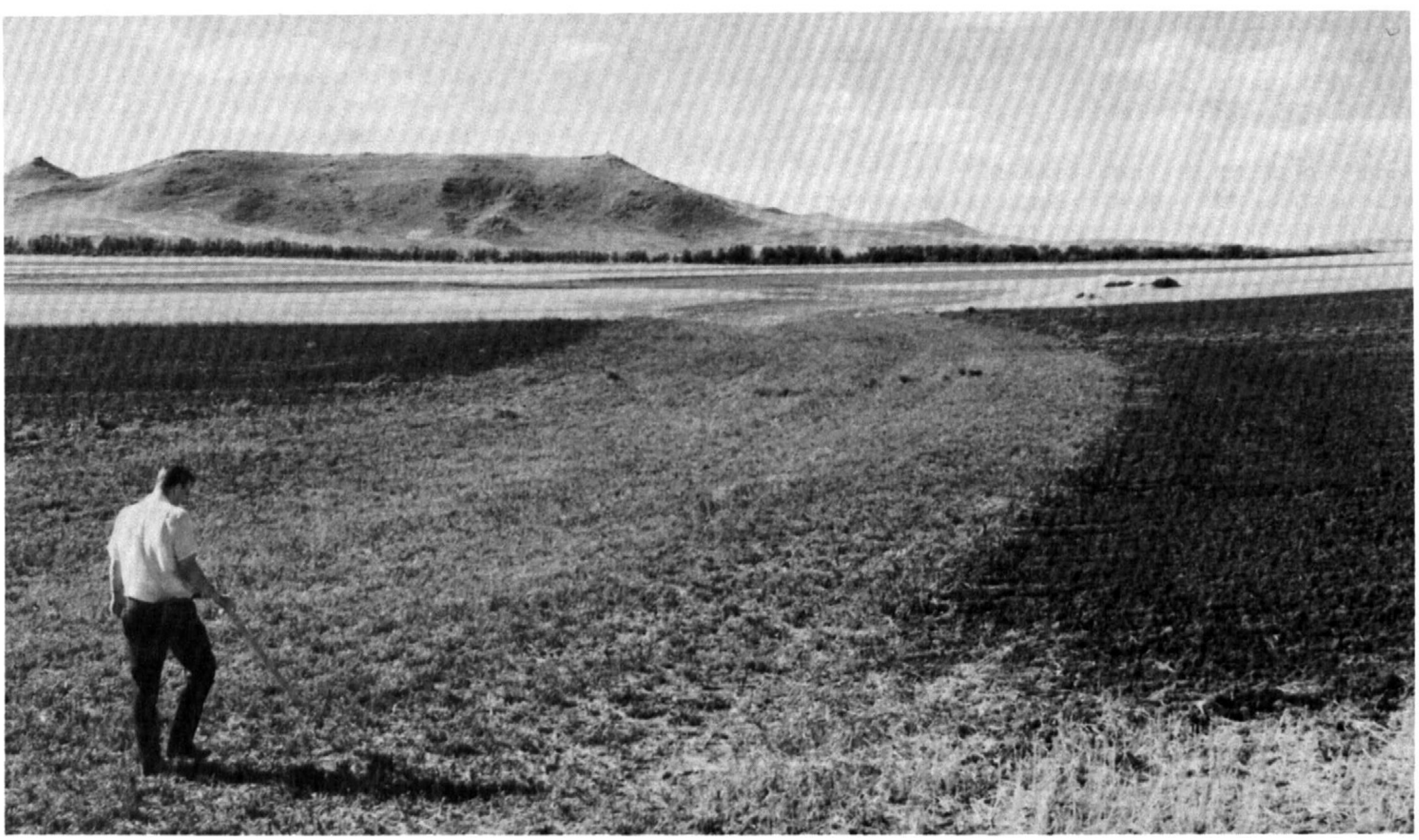


Figure 11.—A grassed waterway in a cultivated area in Adams County.

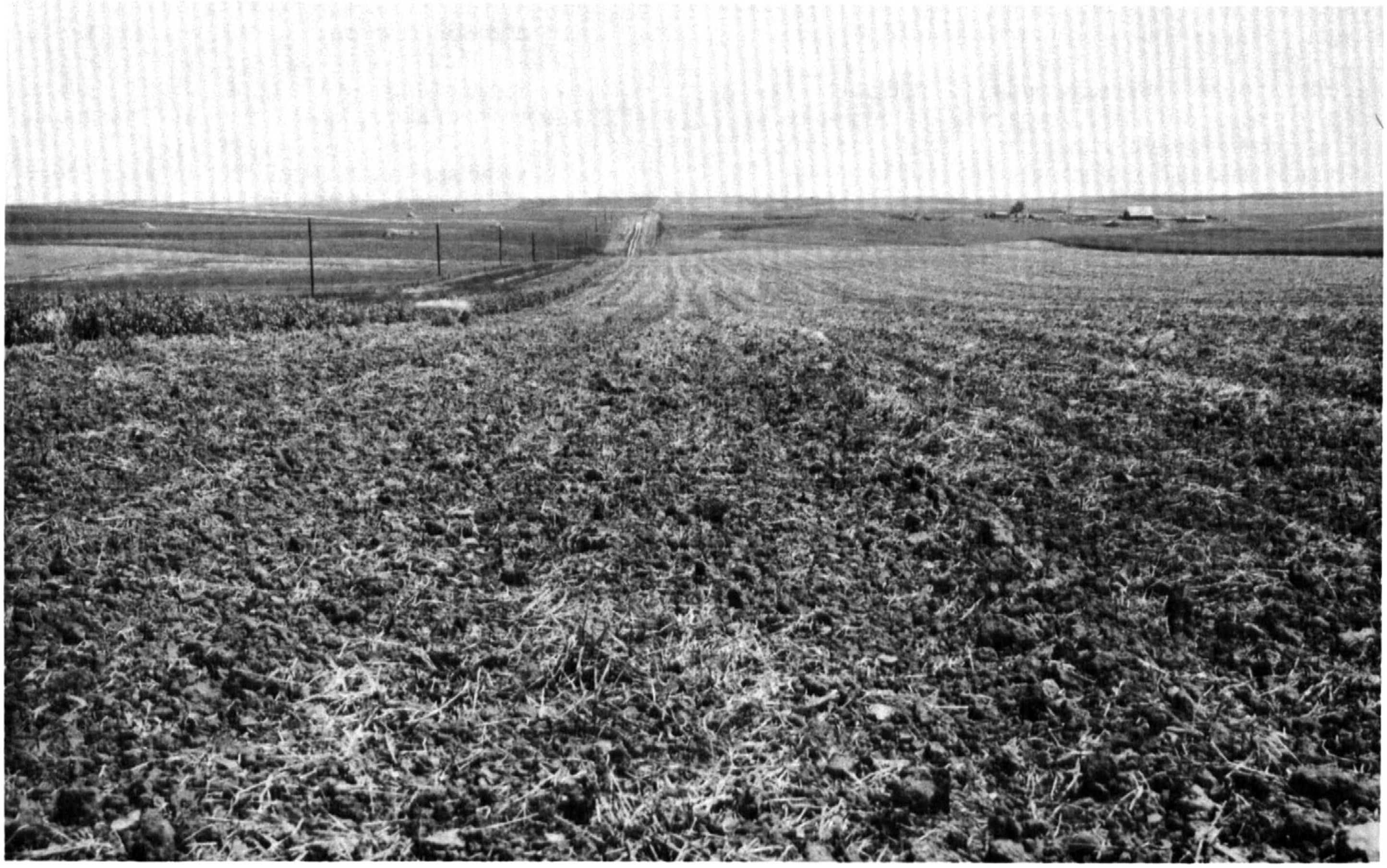


Figure 12.—Crop residue on the surface of a soil assigned to capability subclass IIe. The crop residue, the surface cloddiness, and stripcropping help to control soil blowing and water erosion.

fine sandy loam, saline; and Belfield-Savage-Daglum silt loams, saline, are affected by saline seeps.

Saline soils have a high concentration of soluble salts. The saline soils in Adams County are Regan silt loam; Grail clay loam, saline; Arnegard loam, saline; and Parshall fine sandy loam, saline. Saline seeps are areas of nonirrigated soils where salinity has recently developed. They are basically low-volume springs. The term "saline seep" distinguishes these recently developed saline soils from residual saline soils of preagricultural origin (*6*). A local term for saline soils is "white alkali."

Saline seeps generally develop in areas of restricted drainage. Where drainage is poor, salts rise with the water table and are concentrated near the surface. This salt buildup is reduced by plants and a surface cover. The plant roots use the soil water before it can reach the surface and before the salts accumulate. The surface cover prevents evaporation at the surface, the upward movement of water in the soil, and the concentration of salts at the surface. Residual saline soils, such as the Regan soil, generally form in areas adjacent to natural sloughs and waterways. Saline seeps, on the other hand, commonly develop on the upper slopes. Typically, they develop when precipitation moves through the soil and dissolves salts. The salt-laden water that is not used by crops moves downward through the soil until it reaches an impermeable layer that impedes its progress. It then flows laterally until it discharges in areas where the water table is at or near the surface. As a result, salts are concentrated at or near the surface.

Plants growing on saline soils absorb salts from the soil water. Excess amounts of certain salts may interfere with plant growth. High concentrations of some salts are toxic to certain plants. Some salts cause nutritional imbalances or deficiencies by restricting the uptake or availability of certain plant nutrients. Detecting salinity by visual observations in the field is difficult. The salts are generally not visible during much of the growing season, particularly when the soil is moist. Flecks, threads, or masses of soluble salts are usually visible when the soil is dry. Laboratory analysis is needed to determine the actual degree of salinity in soils.

Crop response, particularly during periods of soil moisture stress, is a useful indicator of the degree of salinity in saline soils. For instance, a small grain crop growing on saline soils tends to be stunted and has fewer tillers than small grain on nonsaline soils. Strongly saline soils are best suited to native grasses or to salt-tolerant introduced grasses. Slightly saline or moderately saline soils can produce salt-tolerant crops and forage species. Barley is the most salt tolerant of the small grains. Of the forage crops, tall wheatgrass, western wheatgrass, and alfalfa are salt tolerant once they are established.

Saline seeps can be controlled by measures that reduce or prevent the flow of soil water from the contributing area to the seep area. The best measures are growing deep-rooted crops, such as alfalfa and sunflowers, and eliminating or reducing fallow in the contributing area. The extent of summer fallow can be reduced by a "flex-cropping" system, in which planting decisions are based on the amount of stored soil moisture. If the amount is adequate at planting time, a crop is planted. Thus, the land is fallowed only in years when the amount of moisture is inadequate at planting time. Barriers that trap snow increase the supply of soil moisture at planting time in the spring and thus help to eliminate the need for fallow. Drainage of saline seeps generally is not feasible in Adams County because disposal of the salty water is a problem.

Alkali soils are characterized by a high content of exchangeable sodium, which adheres to the clay particles in the soil. The alkali soils in Adams County are Belfield, Daglum, and Rhoades silt loams and Ekalaka fine sandy loam. Locally, alkali soils are known as "black-alkali," "slick spots," "pan spots," or "gumbo."

Alkali soils develop in a complex pattern with a very distinct microrelief. The physical and chemical properties of these soils differ markedly within very short distances. In many areas the distance between the alkali soils and the surrounding soils that have normal physical properties is only a few feet, perhaps 5 to 10 feet.

Alkali soils develop in areas of saline soils that contain large quantities of sodium salts. Over a long period, usually centuries, as the water table lowers, rain gradually leaches the salts from the surface to lower horizons. During this leaching process, the clay in the soil becomes saturated with sodium, disperses, and moves downward with the percolating water. As the moving clay concentrates, a dense, alkali subsoil forms. The dense subsoil is hard when dry, sticky when wet, and nearly impervious to roots, water, and air. Examples of soils that have a dense, alkali subsoil are the Daglum and Rhoades silt loams in map unit 12B.

As the leaching by soil water continues, the sodium is gradually removed from the clay particles. The result is a more manageable soil, such as the Belfield silt loam in map units 8 and 8B. If the leaching process continues and nearly all of the sodium is removed from the profile, the soil eventually changes into a nonalkali soil, such as the Savage silt loam in map units 8 and 8B. This change requires a long period, usually centuries (*7*).

If plowed, alkali soils are characterized by a surface layer that is sticky when wet and hard and cloddy when dry. A crust forms easily at the surface. The chemical and physical properties of these soils are unfavorable for plant growth. The harmful effects of the properties on plants generally increase as the sodium content increases. The effects of the reduced amount of water available to plants are more harmful than the toxic effect of the sodium. The plants also are affected by the depth to the dense subsoil.

Identification of alkali soils in cultivated fields commonly is difficult because many of the physical characteristics, such as columnar structure, have been altered by tillage. Crop response, particularly during periods of soil moisture stress, is a useful indicator of the level of alkalinity in a soil. Crops grown on soils with varying amounts of sodium exhibit varying heights and stages of development. If the level of alkalinity is very high, the crop cannot grow. The effects of sodium on crop growth are influenced by weather conditions, the stage of crop growth, and the soil moisture status. A measure of the effect of alkalinity on vegetative growth is not necessarily a reliable measure of crop yields. In many areas the yields of barley and wheat are affected less than the vegetative growth of these crops.

The variability of alkali soils can cause management problems. The alkali soils that have salts within a depth of 16 inches, such as Rhoades soils, are generally best suited to native grasses. The soils that have a dense, alkali subsoil near the surface are generally unsuited to small grain and sunflowers.

Timely tillage is an important management need in areas of the leached alkali soils, such as the Belfield soil in map units 8 and 8B. These areas should be tilled and seeded only when the moisture content is favorable. If worked when too wet, the soil puddles and crusts. If the soil is tilled when too dry, the tillage and seeding implements cannot easily penetrate the soil. Deep plowing and chemical amendments can help to reclaim alkali soils, but they may not be feasible. To be effective, deep tillage should reach to the alkali subsoil and mix several inches of the underlying material with the subsoil and topsoil. Depending on the soil, tillage to a depth of 15 to 36 inches may be needed. Any reclamation of alkali soils is a long-term endeavor. Complete reclamation may never be achieved. Onsite investigation is needed to confirm the feasibility of deep tillage in a particular area.

Saline-alkali soils develop in areas of restricted drainage where salts rise with the water table but where some leaching downward of clay and some saturation with sodium are evident and a dense, alkali subsoil has formed. The saline-alkali soils in Adams County are Harriet loam; Heil silt loam; Belfield silt loam, saline; and Daglum silt loam, saline. The saline Belfield and Daglum soils exhibit a postagricultural reintroduction of a water table and salts into the soil. As a result, they have high salinity and a dense, alkali subsoil. The management needs and crop responses on these soils are a combination of those on saline soils and those on alkali soils.

Additional information about management or reclamation of saline and alkali soils is available from the Soil Conservation Service, the North Dakota Agricultural Experiment Station, and the Cooperative Extension Service.

Yields Per Acre

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

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

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

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.

Productivity Index

The productivity index is a relative rating of the ability of a particular map unit to produce a crop yield in comparison to other map units. The index ranges from 0, which indicates no yield, to 100, which indicates the highest yield. When the index is calculated, the similar and contrasting inclusions are considered as well as the soils specified in the name of the map unit. In Adams County a productivity index of 100 was considered equal to an average yield of 31 bushels per acre of spring wheat. Multiplying the productivity index by 31 and then dividing the product by 100 will convert the index number to a figure representing the expected average yield per acre. Lawther silty clay, 1 to 3 percent slopes, for example, has a productivity index of 83, which when multiplied by 31 and then divided by 100, converts to 26, which is the expected annual yield of spring wheat in bushels per acre for this map unit. (See table 5.)

Land Capability Classification

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

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

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

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

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

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

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

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

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

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

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

This section was prepared by Brian D. Gerbig, range conservationist, Soil Conservation Service.

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.

The native vegetation on rangeland consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. Generally, the plants are suitable for grazing and the plant cover is sufficiently productive to justify grazing. Cultural treatments generally are not used to increase forage production. The composition and production of the plant community are determined by soil, climate, topography, overstory canopy, and grazing management.

In 1980, approximately 220,000 acres in Adams County was rangeland. In areas where it is properly managed, this rangeland is similar to the presettlement prairie of the late 1800's and early 1900's. Most of the rangeland occurs as areas of soils having characteristics that limit their use as cropland. For example, the Flasher-Beisigl-Rock outcrop complex is suited only to native rangeland because of the slope, a low or very low available water capacity, rapid runoff, and a severe erosion hazard. Because of salinity, wetness, and alkalinity, Harriet loam is generally unsuited to uses other than rangeland.

Cow-calf enterprises dominate in the county. A number of ranches also include a yearling enterprise, which adds flexibility during periods of low or high forage production. On some ranches used for a cow-calf enterprise, sheep are raised for improved income stability.

Because of the relatively short growing season, many farmers and ranchers have established cool-season tame pastures to supplement the forage produced on rangeland and to extend the grazing season in the spring and fall. Droughts of short duration are common. As a result, cool-season pastures cannot be grazed in the fall in many years. The farms in Adams County had approximately 34,000 head of cattle in 1980. Hay is grown for livestock on about 37,000 acres each year. Generally, large amounts of hay and feed are needed because of the long winters.

Range Sites and Condition Class

Soils vary in their capacity to produce grasses and other plants suitable for grazing. Soils that produce about the same kinds and amounts of forage are grouped into a range site.

Each range site has a distinctive potential plant community that is referred to as the climax vegetation. The climax vegetation is relatively stable and indicates what the range site is capable of producing. It reproduces itself annually and changes very little as long as the environment remains unchanged. On the prairie the climax vegetation consists of the kinds of plants that grew when the region was settled. It is generally the most productive combination of forage plants that can be grown on the site. When the site is grazed, some of the climax vegetation decreases in extent and some of it increases. Also, other plants invade the site.

Decreaser plants are the species that decline in quantity under close, continuous grazing. They generally are the tallest and most productive grasses and forbs and are the most palatable to livestock.

Increaser plants are the species that increase in quantity under close grazing at the expense of the decreaser species. They generally are the shorter plants or the ones less palatable to livestock.

Invader plants are species normally not included in the climax plant community because they cannot compete with the climax vegetation for moisture, nutrients, and light. They invade the site only after the extent of the climax vegetation has been reduced by continual heavy grazing. Most invader species have little grazing value.

Range condition is determined by standards that are established for each range site. Four range condition classes are used to indicate the present condition of the native vegetation on a range site as compared to the climax vegetation. A range is in *excellent condition* if 76 to 100 percent of the vegetation is the same kind as the climax vegetation, in *good* condition if the percentage is 51 to 75, in *fair* condition if the percentage is 26 to 50, and in *poor* condition if the percentage is 25 or less.

Potential forage production depends on the kind of range site. Current forage production depends on the range condition and the amount of moisture available to the plants during the growing season.

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

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

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of 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, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

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

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

Good range management keeps the range in excellent or good condition. Water is conserved, yields are improved, and soils are protected. The main management concern is recognizing the changes in the plant community that take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall, for example, may lead to the conclusion that the range is in good condition, when actually the plant cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been grazed closely for a short period may have a degraded appearance that temporarily obscures its quality and ability to recover rapidly.

Rangeland can recover from prolonged overuse if the climax decreaser species have not been completely grazed out. If overgrazing is stopped, enough climax plants generally remain for proper grazing use, deferred grazing, and the grazing system to restore the rangeland to an excellent condition. In areas where the climax plant community has been destroyed, range seeding can improve the condition. Seeding the proper climax species also can restore productive rangeland in areas of poor quality cropland. Brush control, development of watering facilities, and other mechanical practices are needed to improve the potential of some rangeland. Fencing is one of the most overlooked means of improving rangeland.

The following paragraphs describe the range sites in Adams County. The names of these sites are Clayey, Claypan, Closed Depression, Overflow, Saline Lowland, Sands, Sandy, Sandy Claypan, Shallow, Shallow Clay, Shallow to Gravel, Silty, Subirrigated, Thin Claypan, Very Shallow, and Wetland.

Clayey range site. This site is dominated by cool-season grasses. Grasses make up approximately 80 percent of the vegetation. The major species are western wheatgrass, green needlegrass, blue grama, needleandthread, and prairie junegrass. Upland sedges make up about 5 percent of the vegetation. Forbs, such as scarlet globemallow, prairie coneflower, western yarrow, prairie thermopsis, and gray sagewort, also make up about 5 percent. Fringed sagebrush, western snowberry, and prairie rose are among the shrubs that make up the rest of the vegetation.

Heavy grazing results in a decrease in the abundance of green needlegrass, needleandthread, and prairie junegrass. Western wheatgrass initially increases in abundance but then also becomes a decreaser. The plants that increase in abundance under these conditions are blue grama, upland sedges, Sandberg bluegrass, and fringed sagebrush. Further deterioration results in a dominance of blue grama, upland sedges, and fringed sagebrush.

Very few problems affect management of this site. The water intake rate is slow. As a result, an adequate cover of vegetation is needed to help ensure that forage production is not reduced by runoff. Areas where the range is in poor or fair condition can generally be restored to good or excellent condition by good management of the remnant climax species.

Claypan range site. The climax vegetation on this site is mainly western wheatgrass, blue grama, green needlegrass, needleandthread, and prairie junegrass. These grasses and small amounts of others make up about 80 percent of the vegetation. Upland sedges make up about 10 percent. Forbs, such as silverleaf scurfpea, rush skeletonplant, and scarlet globemallow, make up about 5 percent. Fringed sagebrush, broom snakeweed, and other shrubs make up the rest.

The principal decreasers are western wheatgrass, green needlegrass, prairie junegrass, and needleandthread. The increasers are blue grama, inland saltgrass, Sandberg bluegrass, upland sedges, and fringed sagebrush. Further deterioration results in a dominance of blue grama, inland saltgrass, upland sedges, fringed sagebrush, and undesirable forbs.

This site is easily damaged by overgrazing. Because of a dense subsoil and the content of salts in the soil, reestablishing the vegetation is difficult in denuded areas. Careful management that maintains the abundance of the key plants is the best way to maintain forage production and protect the soil from water erosion.

Closed Depression range site. The climax vegetation on this site is mainly western wheatgrass, prairie cordgrass, slender wheatgrass, fowl bluegrass, and foxtail barley. These grasses and small amounts of other grasses make up about 80 percent of the vegetation. Common spikesedge makes up about 5 percent. The rest is forbs, such as curled dock, povertyweed, Nuttall cinquefoil, and smartweed.

The principal decreasers are prairie cordgrass, common spikesedge, and slender wheatgrass. The increasers are western wheatgrass, foxtail barley, fowl bluegrass, inland saltgrass, and needle spikesedge. Further deterioration results in a dominance of fowl bluegrass, foxtail barley, inland saltgrass, curlycup gumweed, and povertyweed.

This site is easily damaged by overgrazing. Livestock are attracted to this site because of the supply of moisture. As a result, the site is frequently overgrazed and damaged by trampling. A properly designed grazing system can restore the climax vegetation to its potential.

Overflow range site. The potential plant community on this site is mainly big bluestem, western wheatgrass, green needlegrass, needleandthread, little bluestem, porcupinegrass, and blue grama. These and other grasses make up as much as 80 percent of the vegetation. Pennsylvania sedge, fescue sedge, and other grasslike plants make up about 5 percent. Stiff sunflower, heath aster, prairie coneflower, Missouri goldenrod, and other forbs make up about 10 percent. The rest is western snowberry, juneberry, chokecherry, and other shrubs.

Overgrazing results in a decrease in the abundance of big bluestem, green needlegrass, porcupinegrass, and needleandthread. The plants that readily increase in abundance under these conditions are blue grama, western wheatgrass, Pennsylvania sedge, fescue sedge, and Kentucky bluegrass. If overuse continues, the plant community is dominated by blue grama, Pennsylvania sedge, Kentucky bluegrass, and other low-growing grasses and sedges.

Because of its position on the landscape, this site is frequently overgrazed. Fencing generally is not feasible because of the small size or the shape of areas of this site. As a result of flooding and the runoff received by these areas, this is a very productive site when properly managed. A planned grazing system can restore the site and maintain a high level of productivity. Reseeding is needed in areas that have been farmed. In areas where shrubs dominate, brush control can help to restore productivity.

Saline Lowland range site. The potential plant community on this site consists of salt-tolerant species. Western wheatgrass, Nuttall alkaligrass, inland saltgrass, slender wheatgrass, foxtail barley, plains bluegrass, alkali cordgrass, and alkali muhly are the principal grasses. Grasses make up approximately 85 percent of the vegetation. Prairie bulrush and other grasslike plants make up about 5 percent. Alkali plaintain, silver cinquefoil, Pursh seepweed, dock, and minor amounts of other forbs make up the rest.

Heavy grazing results in a decrease in the abundance of Nuttall alkaligrass, slender wheatgrass, plains bluegrass, alkali cordgrass, and western wheatgrass and an increase in the abundance of inland saltgrass, foxtail barley, alkali muhly, and mat muhly. If heavy grazing continues, inland saltgrass, foxtail barley, and low-quality forbs, such as Pursh seepweed, western dock, and silver cinquefoil, dominate the site.

A high content of salts and a restricted available water capacity limit forage production on this site. Careful management of the adapted salt-tolerant plants can maintain good forage production. If the plant community has been severely damaged, however, the site recovers slowly. Soil blowing and water erosion are hazards in denuded areas. Stock water ponds on this site frequently contain salty water. If feasible, alternative water sources should be developed.

Sands range site. The climax vegetation on this site is dominated by midgrasses. Needleandthread and prairie sandreed are the principal species. Other grasses are sand bluestem, blue grama, prairie junegrass, and western wheatgrass. Grasses make up about 75 percent of the vegetation. Upland sedges make up about 10 percent. Forbs, such as stiff goldenrod, purple coneflower, hairy goldaster, gray goldenrod, prairie spiderwort, and green sagewort, and woody shrubs, such as leadplant amorpha, prairie rose, western snowberry, and fringed sagebrush, make up the rest.

Overgrazing results in a decrease in the abundance of prairie sandreed, sand bluestem, prairie junegrass, little bluestem, purple prairie-clover, purple coneflower, and leadplant amorpha. Needleandthread initially increases in abundance but then decreases if overgrazing continues. The principal increasers are sand dropseed, blue grama, upland sedges, green sagewort, and fringed sagebrush. Continued heavy grazing results in a dominance of blue grama, upland sedges, green sagewort, and fringed sagebrush unless soil blowing has affected the site.

A low available water capacity and the hazard of soil blowing are concerns in managing this site. Measures that minimize the formation of livestock trails and that do not allow the animals to concentrate in an area for too long a time are needed. In severely overgrazed areas, blowouts are common. On large blowouts, shaping, seeding, and mulching are needed before the climax vegetation can be reestablished. The vegetation in areas where the site is in fair or poor condition responds rapidly to improved grazing management.

Sandy range site. Grasses make up about 75 percent of the climax vegetation on this site. Needleandthread and prairie sandreed are the principal species. Other grasses are western wheatgrass, green needlegrass, prairie junegrass, and blue grama. Upland sedges make up about 10 percent of the vegetation. Forbs, such as silverleaf scurfpea, shell-leaf penstemon, goldenrod, western yarrow, prairie spiderwort, and gray sagewort, also make up about 10 percent. Silver sagebrush, prairie rose, leadplant amorpha, and western snowberry make up the rest.

Overgrazing results in a decrease in the abundance of prairie sandreed, green needlegrass, western wheatgrass, prairie junegrass, and leadplant amorpha. Needleandthread initially responds as an increaser and then decreases in abundance if overgrazing continues. The species that increase in abundance are blue grama, upland sedges, sand dropseed, green sagewort, and silver sagebrush. Further deterioration results in a dominance of blue grama, upland sedges, silver sagebrush, green sagewort, and other low-quality forbs.

A low or moderate available water capacity is a concern in managing this site. Also, soil blowing is a hazard in denuded areas. Management that maintains the abundance of the key species results in a natural plant community that provides excellent forage for livestock and a protective plant cover.

Sandy Claypan range site. Short grasses dominate this site. The principal species are western wheatgrass, needleandthread, and blue grama. Other species are sun sedge, other upland sedges, and a small number of perennial forbs. The common woody plants are silver sagebrush, fringed sagebrush, and western snowberry.

Continual heavy grazing results in a decrease in abundance of such plants as western wheatgrass and needleandthread. The plants that increase in abundance under these conditions are blue grama, upland sedges, and fringed sagebrush. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagebrush, annual forbs, and annual grasses.

Forage production varies on this site. The soil has a dense, alkali subsoil and a limited available water capacity. The site is fragile, and the natural plant community can deteriorate rapidly. Management that maintains a protective plant cover is needed to control erosion.

Shallow range site. The principal climax species on this site are little bluestem, needleandthread, western wheatgrass, plains muhly, blue grama, sideoats grama, and prairie sandreed. Grasses make up about 75 percent of the vegetation. Upland sedges make up about 10 percent. Forbs, such as blacksamson, hairy goldaster, skeletonweed, purple prairieclover, dotted gayfeather, stiff sunflower, and green sagewort, also make up about 10 percent. Shrubs and half-shrubs, such as fringed sagewort, common winterfat, western snowberry, and shrubby cinquefoil, make up the rest.

Heavy grazing results in a decrease in the abundance of little bluestem, needleandthread, sideoats grama, prairie sandreed, blacksamson, purple prairie-clover, stiff sunflower, and dotted gayfeather. Initially, western wheatgrass tends to increase in abundance, but then it decreases. Blue grama, upland sedges, red threeawn, green sagewort, and fringed sagewort are increasers. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagewort, green sagewort, and other unpalatable forbs.

Because of a low available water capacity, forage production is limited on this site. Water erosion is a hazard in areas that have a slope of more than 5 percent. Gullies form readily along cattle trails and in denuded areas. Management that maintains the key plants and cross fencing, which helps to control the pattern of livestock traffic, help to maintain productivity. A planned grazing system is an excellent method of restoring productivity if the site has deteriorated.

Shallow Clay range site. The principal climax species on this site are western wheatgrass, green needlegrass, blue grama, plains muhly, and Sandberg bluegrass. These and other grasses make up about 80 percent of the vegetation. Forbs, such as prairie thermopsis, povertyweed, wooly indianwheat, and rush skeletonplant, make up about 10 percent. Shrubs and half-shrubs, such as fringed sagebrush, broom snakeweed, big sagebrush, and Nuttall saltbush, make up the rest.

Heavy grazing results in a decrease in the abundance of western wheatgrass, green needlegrass, plains muhly, and prairie junegrass. Initially, blue grama, Sandberg bluegrass, inland saltgrass, needleleaf sedge, and other upland sedges increase in abundance under these conditions. Further deterioration results in a dominance of blue grama, fringed sagebrush, upland sedges, and unpalatable forbs.

This site is fragile because of shallow soil depth and a limited available water capacity. Management that maintains an adequate plant cover helps to protect the soil from erosion. Gullies can form along cattle trails and in denuded areas. A planned grazing system is an excellent method of restoring productivity when the site is in poor or fair condition.

Shallow to Gravel range site. Grasses make up about 70 percent of the climax vegetation on this site. Needleandthread, western wheatgrass, green needlegrass, blue grama, plains muhly, red threeawn, and prairie junegrass are the principal species. Upland sedges make up about 15 percent of the vegetation. Forbs, such as rush skeletonplant, scarlet globemallow, dotted gayfeather, wooly goldenrod, and Hood phlox, make up about 10 percent. Fringed sagebrush and other shrubs make up the rest.

Continual heavy grazing results in a decrease in the abundance of western wheatgrass, green needlegrass, and needleandthread. The principal increasers are blue grama, red threeawn, upland sedges, Kentucky bluegrass, fringed sagebrush, and several forbs. Blue grama, red threeawn, upland sedges, fringed sagebrush, and low-quality forbs dominate the site when it is in poor condition.

Because of a low available water capacity, forage production is limited on this site. Water erosion is a hazard in areas that have a slope of more than 5 percent. Gullies can form along cattle trails and in denuded areas. Management that maintains an adequate cover of the key plants, which trap snow, and cross fencing, which helps to control the pattern of livestock traffic, help to maintain productivity.

Silty range site. Grasses make up about 75 percent of the climax vegetation. The major species are western wheatgrass, needleandthread, green needlegrass, blue grama, prairie junegrass, porcupinegrass, red threeawn, and Sandberg bluegrass. Upland sedges make up about 5 percent of the vegetation. Forbs, such as heath aster, prairie coneflower, green sagewort, scarlet globemallow, Hood phlox, and purple prairie-clover, make up about 10 percent. Shrubs, such as fringed sagebrush, western snowberry, silver sage, common winterfat, and prairie rose, make up the rest.

Overgrazing results in a decrease in the abundance of green needlegrass, porcupinegrass, and prairie junegrass. Western wheatgrass and needleandthread initially respond as increasers. If overgrazing continues, however, they decrease in abundance. Blue grama, Sandberg bluegrass, red threeawn, upland sedges, and a number of forbs are increasers. In areas with a long history of overgrazing, blue grama, red threeawn, upland sedges, fringed sagebrush, and green sagewort dominate the site.

Generally, no major problems affect management of this site. In the more sloping areas, however, gullies can form along livestock trails. Fencing and improved grazing management help to prevent gullying and improve gullied areas. Areas where the site is in poor or fair condition generally can be restored to good or excellent condition by good management. In some areas brush control is needed.

Subirrigated range site. The potential plant community on this site is dominated by tall, warm-season grasses, mainly big bluestem, switchgrass, indiangrass, and prairie cordgrass. These species and the mid grasses, mainly little bluestem, make up about 85 percent of the vegetation. Sedges, Baltic rush, and common spikesedge make up about 5 percent. Maximilian sunflower, Rydberg sunflower, tall goldenrod, tall white aster, common wild mint, and other forbs make up about 10 percent.

When overgrazed, big bluestem, switchgrass, indiangrass, Maximilian sunflower, and Rydberg sunflower are rapidly depleted. Little bluestem initially increases in abundance but then decreases. The major increasers are mat muhly, fowl bluegrass, Baltic rush, common spikerush, common wild mint, and rough cinquefoil. Continued heavy grazing results in a dominance of Kentucky bluegrass, Baltic rush, mat muhly, and undesirable sedges and grasses.

Because of the high percentage of warm-season grasses, this site can provide high-quality forage later in the growing season than many other sites. Where the plant community has deteriorated, deferment of grazing during the growing season or a planned grazing system can restore the site. In areas where the potential plant community has been destroyed by cultivation or by extremely severe overuse, range seeding can reestablish the major grass species.

Thin Claypan range site. The climax vegetation on this site is about 60 percent western wheatgrass and blue grama. Other grasses make up about 20 percent of the vegetation. Upland sedges and forbs each make up about 5 percent. Shrubs and half-shrubs make up the rest.

Western wheatgrass is the principal decreaser when this site is overgrazed. Other decreasers are prairie junegrass, wheatgrasses, and needleandthread. Blue grama, inland saltgrass, Sandberg bluegrass, and buffalograss are the principal increasers. Continued overgrazing results in a dominance of inland saltgrass, blue grama, other short grasses, upland sedges, fringed sagebrush, and broom snakeweed.

Because of the high content of salts near the surface, productivity is quite low on this site. The site produces good-quality forage only if properly managed. If the site is in poor or fair condition, recovery is quite slow because of the salts and a dense, sodic subsoil. Stock water pits should not be constructed on this site because the water is likely to be salty. Careful management can maintain or restore the site to good or excellent condition. If the vegetation has been destroyed by cultivation or the site denuded, range seeding can restore the climax vegetation. Good seeding techniques are needed.

Very Shallow range site. About 80 percent of the climax vegetation on this site is needleandthread, western wheatgrass, little bluestem, blue grama, prairie junegrass, plains muhly, red threeawn, and other grasses. Upland sedges make up about 10 percent of the vegetation. Green sagewort, rush skeletonplant, dotted gayfeather, purple prairie-clover, western yarrow, and other forbs make up about 5 percent. Broom snakeweed, fringed sagebrush, and other shrubs make up the rest.

Western wheatgrass, needleandthread, prairie junegrass, and purple prairie-clover are the principal decreasers when this site is overgrazed. Blue grama, upland sedges, red threeawn, fringed sagebrush, and broom snakeweed are the principal increasers. Continued heavy use results in a dominance of upland sedges, red threeawn, fringed sagebrush, broom snakeweed, and a number of undesirable forbs.

Available water capacity is very low on this site. Also, water erosion is a hazard in the more sloping areas. Gullies can readily form along cattle trails and in denuded areas. The site is frequently overgrazed. Once it is in fair or poor condition, it recovers slowly because of the limited supply of available moisture. Productivity can be maintained by careful management of the mid grasses and by cross fencing, which helps to control livestock traffic patterns.

Wetland range site. The potential plant community on this site is about 50 percent grasses and 45 percent grasslike plants. The principal species are rivergrass and slough sedge. Other species are prairie cordgrass, northern reedgrass, American mannagrass, American sloughgrass, slim sedge, common spikesedge, and Baltic rush. Forbs, such as longroot smartweed, curled dock, Rydberg sunflower, false aster, and tall white aster, make up about 5 percent of the vegetation.

If this site is continuously overgrazed, rivergrass and slough sedge are the principal decreasers. Slim sedge, Baltic rush, common spikesedge, and American sloughgrass are increasers. Heavy grazing results in a plant community dominated by Baltic rush, common spikesedge, false aster, and curled dock.

If possible, grazing should be limited to summer and fall on this site. Grazing during wet periods can result in compaction and root damage. A deteriorated plant community can be restored by deferment of grazing during the growing season or by a planned grazing system. In areas where the natural plant community has been destroyed, seeding reed canarygrass and creeping foxtail helps to restore forage production. If possible, this site should be fenced from other range sites.

Windbreaks and Environmental Plantings

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

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

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

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

Recreation

This section was prepared by Erling B. Podoll, biologist, Soil Conservation Service.

Adams County has few public recreation areas. Recreation activities requiring open space, such as birding, hiking, snowmobiling, and cross-county skiing, are restricted to private land. Hunting opportunities also are restricted to private land.

One city-owned and one private reservoir are available for boating, but they have no basic facilities. North Lemmon Lake, a state-owned reservoir, is available for boating and fishing but has limited basic facilities.

Hettinger provides facilities for recreation activities, such as swimming, tennis, horseshoe, picnicking, ice skating, and baseball. Reeder City Park has facilities for picnicking. The county has one private golf course.

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

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

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

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

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

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

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

Wildlife Habitat

This section was prepared by Erling B. Podoll, biologist, Soil Conservation Service.

Wildlife resources provide opportunities for hunting and trapping in Adams County. Fishery resources are limited to one reservoir and one stream.

Wildlife populations have been reduced substantially since the county was settled. Species composition has not changed so drastically because the county still has a fair diversity of habitats. Important bird species include game birds, such as pheasant, sharp-tailed grouse, gray partridge, mourning dove, and ducks. Important mammals include white-tailed deer, mule deer, raccoon, mink, badger and white-tailed jackrabbit.

A little more than 0.5 percent of the state's upland game hunters reside in Adams County. The county accounts for less than 0.4 percent of the waterfowl hunting and a little more than 4 percent of the annual pheasant harvest in the state. The average annual harvest of deer is about 400 animals.

Public fishing water is limited to North Lemmon Lake, which is managed for trout fishing. When the water level is high, Cedar Creek can be fished for walleye, northern pike, and sauger. The potential for the construction of small fishing ponds is fair.

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

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

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

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

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

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 common chokecherry, silver buffaloberry, and silver 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, wild millet, 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 gray partridge, pheasant, meadowlark, field sparrow, cottontail, and red fox.

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 beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sharptail grouse, meadowlark, and lark bunting.

Engineering

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

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

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

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

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

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

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

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

Building Site Development

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

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

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

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

Sanitary Facilities

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

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

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

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

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

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

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

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

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

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

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

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

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

Construction Materials

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Water Management

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

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

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

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

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

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

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

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

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

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

Soil Properties

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

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

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

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

Engineering Index Properties

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

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

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

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

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

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

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

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

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

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

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

Physical and Chemical Properties

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

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

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

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

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

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

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

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

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

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

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

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly

erodible. Crops can be grown if intensive measures to control soil blowing are used.

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

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

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

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

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

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

Soil and Water Features

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

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

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

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

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

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

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table, the kind of water table, and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16. 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.

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 either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

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

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

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

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

Engineering Index Test Data

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

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

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

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*17*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that has a mean annual soil temperature of less than 47 degrees).

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 Haploborolls.

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

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

Soil Series and Their Morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*16*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*17*). 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."

Amor Series

The Amor series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft bedrock. Slope ranges from 3 to 25 percent.

Typical pedon of Amor loam, 3 to 6 percent slopes, 825 feet west and 530 feet north of the southeast corner of sec. 27, T. 132 N., R. 98 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure and weak medium and fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; neutral; abrupt smooth boundary.

Bw1—8 to 14 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; very few faint clay films on faces of peds; neutral; clear smooth boundary.

Bw2—14 to 22 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; common iron stains, yellowish brown (10YR 5/6) moist; neutral; gradual wavy boundary.

Bk1—22 to 30 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic and weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; few fine irregularly shaped masses and threads of soft lime; slight effervescence; moderately alkaline; clear smooth boundary.

Bk2—30 to 36 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic and weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine pores; common fine irregularly shaped masses and threads of soft lime; strong effervescence; moderately alkaline; clear smooth boundary.

Cr—36 to 60 inches; light gray (2.5Y 7/2) and pale yellow (5Y 7/3) soft stratified siltstone and sandstone, light brownish gray (2.5Y 6/2) and pale olive (5Y 6/3) moist.

The thickness of the solum ranges from 10 to 40 inches and the depth to soft bedrock from 20 to 40 inches. The depth to free carbonates ranges from 10 to 25 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has value of 3 to 5 (2 or 3 moist). The Bw horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 to 4. It is loam or clay loam. The Bk horizon also is loam or clay loam. It has value of 6 or 7 (4 to 6 moist) and chroma of 2 to 4.

Arnegard Series

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

Typical pedon of Arnegard loam, 1 to 3 percent slopes, 2,475 feet south and 100 feet east of the northwest corner of sec. 18, T. 130 N., R. 97 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium and coarse subangular blocky and weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; neutral; abrupt smooth boundary.

Bw1—9 to 15 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; coatings of very dark brown (10YR 2/2) moist; interior of some peds dark brown (10YR 3/3) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; very few thin clay films on faces of peds; neutral; clear smooth boundary.

Bw2—15 to 24 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; coatings of very dark brown (10YR 2/2) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; very few thin clay films on faces of peds; neutral; gradual smooth boundary.

Bw3—24 to 31 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak medium and coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; mildly alkaline; clear smooth boundary.

Bk—31 to 42 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak very coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; common fine and medium irregularly shaped soft lime masses; violent effervescence; moderately alkaline; clear smooth boundary.

C—42 to 60 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; common fine irregularly shaped soft lime masses; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 52 inches. The mollic epipedon is 16 to 30 inches thick. The depth to carbonates ranges from 20 to 45 inches. Some pedons are saline.

The A horizon has value of 3 or 4 (2 or 3 moist). The Bw horizon has value of 4 or 5 (3 or 4 moist). It is loam, silt loam, or clay loam. The C horizon has hue of 2.5Y or

10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is fine sandy loam, loam, or clay loam.

Beisigl Series

The Beisigl series consists of moderately deep, somewhat excessively drained, rapidly permeable soils on uplands. These soils formed in material weathered from soft sandstone. Slope ranges from 1 to 45 percent.

Typical pedon of Beisigl loamy fine sand, in an area of Beisigl-Flasher loamy fine sands, 6 to 20 percent slopes, 1,460 feet south and 100 feet west of the northeast corner of sec. 15, T. 129 N., R. 92 W.

A—0 to 5 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine pores; about 1 percent sandstone channers; slight effervescence; mildly alkaline; clear smooth boundary.

Bk1—5 to 12 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine pores; about 1 percent sandstone channers; disseminated lime; strong effervescence; moderately alkaline; clear smooth boundary.

Bk2—12 to 27 inches; pale yellow (2.5Y 7/4) loamy fine sand, light yellowish brown (2.5Y 6/4) moist; weak coarse and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine pores; about 1 percent sandstone channers; disseminated lime; strong effervescence; moderately alkaline; gradual smooth boundary.

Cr—27 to 60 inches; pale yellow (2.5Y 7/4) soft sandstone, light yellowish brown (2.5Y 6/4) moist.

The depth to soft bedrock generally is 24 to 35 inches but ranges from 20 to 40 inches. The soils typically are calcareous throughout, but in some pedons the A horizon is noncalcareous.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. The Bk horizon has hue of 2.5Y or 10YR, value of 6 or 7 (5 or 6 moist), and chroma of 3 or 4. It is loamy fine sand, fine sand, or loamy sand.

Belfield Series

The Belfield series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from soft bedrock or in alluvium. Slope ranges from 1 to 6 percent.

Typical pedon of Belfield silt loam, in an area of Belfield-Savage-Daglum silt loams, 1 to 3 percent slopes, 495 feet south and 100 feet west of the northeast corner of sec. 29, T. 130 N., R. 96 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky and moderate fine granular structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; slightly acid; abrupt smooth boundary.

A—6 to 9 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium subangular and angular blocky; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; common fine coatings of light gray (10YR 6/1); slightly acid; clear smooth boundary.

B/E—9 to 12 inches; grayish brown (10YR 5/2) silty clay loam (B), very dark grayish brown (10YR 3/2) moist; light gray (10YR 6/1) silt coatings on faces of peds (E); strong fine and medium angular blocky structure; very hard, firm, sticky and plastic; common very fine roots; many very fine pores; common thin clay films on faces of peds; neutral; clear smooth boundary.

Bt—12 to 20 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; some interfingering of light gray (10YR 6/1) throughout; moderate coarse prismatic structure parting to strong fine and medium angular blocky; very hard, very firm, very sticky and very plastic; common very fine roots; many very fine pores; common faint clay films on faces of peds; neutral; clear wavy boundary.

Bk—20 to 33 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common very fine roots; many very fine pores; common fine threads of soft lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—33 to 60 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist and crushed; weak medium and coarse subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine pores; few fine and medium threads of soft lime; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 25 inches. The thickness of the solum ranges from 17 to 35 inches. The depth to carbonates is 20 to 35 inches. Some pedons are saline.

The A horizon has value of 4 or 5 (2 or 3 moist). The Bt horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 4. It is silty clay, clay, or silty clay loam. The C horizon is silty clay loam, clay loam, or silt loam and is stratified with coarser textured material. Some pedons have weathered shale at a depth of 40 to 60 inches.

Bowdle Series

The Bowdle series consists of deep, well drained soils on terraces. These soils formed in loamy sediments that are moderately deep over sand and gravel. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slope ranges from 0 to 6 percent.

Typical pedon of Bowdle loam, 0 to 3 percent slopes, 75 feet south and 2,515 feet west of the northeast corner of sec. 29, T. 132 N., R. 96 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; about 2 percent gravel; neutral; abrupt smooth boundary.

Bw1—5 to 15 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; coatings of organic matter on faces of peds, very dark grayish brown (10YR 3/2) moist; about 2 percent gravel; neutral; clear smooth boundary.

Bw2—15 to 19 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; about 2 percent gravel; calcium carbonate coatings on undersides of pebbles; mildly alkaline; clear smooth boundary.

Bk1—19 to 26 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine pores; about 5 percent gravel; many medium generally rounded soft lime masses; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—26 to 31 inches; grayish brown (2.5Y 5/2) gravelly sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; about 15 percent gravel; few fine irregularly shaped soft lime masses; lime accumulations on undersides of pebbles; violent effervescence; moderately alkaline; clear wavy boundary.

2C1—31 to 36 inches; light brownish gray (2.5Y 6/2) very gravelly loamy sand, grayish brown (2.5Y 5/2) moist; single grain; loose, nonsticky and nonplastic; few fine roots; about 40 percent gravel; lime accumulations on undersides of pebbles; strong effervescence; moderately alkaline; abrupt smooth boundary.

2C2—36 to 60 inches; light olive brown (2.5Y 5/4) stratified sand and gravel, olive brown (2.5Y 4/4) moist; single grain; loose, nonsticky and nonplastic; slight effervescence; mildly alkaline.

The mollic epipedon is 16 to 25 inches thick. The depth to carbonates is 15 to 25 inches. The depth to sand and gravel ranges from 20 to 40 inches. The thickness of the solum ranges from 15 to 34 inches.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 2. The Bw horizon is loam or clay loam. The Bk horizon has hue of 2.5Y or 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam, gravelly loam, or gravelly sandy loam.

Brandenburg Series

The Brandenburg series consists of excessively drained soils on uplands. These soils are shallow over porcelanite (scoria) beds. They formed in material weathered from shattered porcelanite. Permeability is moderate in the upper part of the profile and very rapid in the lower part. Slope ranges from 6 to 70 percent.

Typical pedon of Brandenburg channery sandy loam, in an area of Cabba-Brandenburg-Savage complex, 6 to 70 percent slopes, 2,340 feet south and 50 feet east of the northwest corner of sec. 31, T. 130 N., R. 93 W.

A—0 to 5 inches; reddish brown (5YR 5/3) channery sandy loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure parting to moderate fine granular; soft, very friable, nonsticky and nonplastic; many very fine roots, matted in the lower part; many very fine pores; about 25 percent porcelanite channers; slight effervescence; mildly alkaline; clear wavy boundary.

C1—5 to 18 inches; reddish brown (5YR 5/3) very channery sandy loam, reddish brown (5YR 4/3) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; common very fine pores; about 50 percent porcelanite channers; accumulations of lime on undersides of porcelanite channers; slight effervescence; mildly alkaline; clear smooth boundary.

C2—18 to 60 inches; light red (2.5YR 6/8 and 10R 6/8) shattered porcelanite bedrock, red (2.5YR 5/8 and 10R 5/8) moist; some loamy material in the upper part; accumulations of lime on undersides of porcelanite fragments; slight effervescence; mildly alkaline.

The depth to shattered porcelanite bedrock ranges from 10 to 20 inches. The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 (3 or 4 moist), and chroma of 2 or 3. The C1 horizon is dominantly very channery sandy loam, but the range includes very channery loam. The C2 horizon is shattered porcelanite or clinkers.

Cabba Series

The Cabba series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft bedrock. Slope ranges from 6 to 70 percent.

Typical pedon of Cabba loam, in an area of Cabba-Brandenburg-Savage complex, 6 to 70 percent slopes, 2,115 feet south and 100 feet east of the northwest corner of sec. 31, T. 130 N., R. 93 W.

A—0 to 4 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine pores; violent effervescence; moderately alkaline; clear smooth boundary.

Bk—4 to 13 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine pores; few reddish yellow (7.5YR 6/6) iron stains; many fine soft lime masses; violent effervescence; moderately alkaline; clear smooth boundary.

C—13 to 17 inches; pale olive (5Y 6/3) loam, olive (5Y 5/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and few fine roots; common fine pores; few strong brown (7.5YR 5/6) iron stains; about 50 percent soft siltstone fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Cr—17 to 60 inches; pale olive (5Y 6/3) soft siltstone and sandstone bedrock, olive (5Y 5/3) moist.

The depth to soft bedrock ranges from 10 to 20 inches. The A horizon has hue of 2.5Y or 10YR and value of 5 or 6 (3 or 4 moist). It is loam or silt loam. The Bk horizon has hue of 2.5Y or 5Y and value of 5 to 8 (4 to 6 moist). It is silt loam, loam, or silty clay loam. Some pedons do not have a Bk horizon.

Chama Series

The Chama series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft siltstone. Slope ranges from 6 to 35 percent.

Typical pedon of Chama silt loam, in an area of Chama-Cabba silt loams, 6 to 9 percent slopes, 2,560 feet south and 45 feet west of the northeast corner of sec. 20, T. 131 N., R. 96 W.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; strong effervescence; mildly alkaline; abrupt smooth boundary.

Bw—8 to 14 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; violent effervescence; moderately alkaline; clear wavy boundary.

Bk1—14 to 20 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; common medium and large soft lime masses; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—20 to 33 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine roots; common very fine pores; common fine and medium soft lime masses; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—33 to 60 inches; pale yellow (2.5Y 8/4) and light gray (5Y 7/2) soft siltstone bedrock, light yellowish brown (2.5Y 6/4) and light olive gray (5Y 6/2) moist.

The thickness of the solum ranges from 15 to 36 inches and the depth to soft siltstone bedrock from 20 to 40 inches. The mollic epipedon is 7 to 10 inches thick.

The A horizon has hue of 2.5Y or 10YR and value of 3 to 5 (2 or 3 moist). The Bw horizon has hue of 2.5Y or 10YR and value of 4 to 6 (3 to 5 moist). It is silt loam or silty clay loam. The Bk horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silt loam or silty clay loam.

Daglum Series

The Daglum series consists of deep, well drained and moderately well drained, very slowly permeable, alkali soils on uplands. These soils formed in material weathered from soft bedrock or in alluvium. Slope ranges from 1 to 25 percent.

Typical pedon of Daglum silt loam, in an area of Belfield-Savage-Daglum silt loams, 1 to 3 percent slopes, 1,950 feet east and 1,355 feet north of the southwest corner of sec. 26, T. 132 N., R. 98 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky and moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; slightly acid; abrupt smooth boundary.

E—7 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure parting to moderate fine subangular blocky and weak medium platy; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; light gray (10YR 7/2) coatings; slightly acid; clear smooth boundary.

Bt1—8 to 14 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong fine and medium columnar structure parting to strong fine and medium angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine roots along faces of peds; many very fine pores; light gray (10YR 7/2) silt coatings on the tops of columns; many faint clay films on faces of peds; coatings on faces of prisms, very dark brown (10YR 2/2) moist; mildly alkaline; gradual smooth boundary.

Bt2—14 to 18 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong medium and coarse prismatic structure parting to strong fine and medium angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine roots along faces of peds; many very fine pores; many faint clay films on faces of peds; coatings on faces of prisms, very dark brown (10YR 2/2) moist; moderately alkaline; clear smooth boundary.

Bky1—18 to 26 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; strong fine and medium subangular and angular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; many very fine pores; few thin clay films on faces of peds; coatings of very dark grayish brown (10YR 3/2) moist; few fine gypsum crystals; common fine and medium irregularly shaped soft lime masses; strong effervescence; strongly alkaline; clear smooth boundary.

Bky2—26 to 32 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak very coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common very fine roots; common very fine pores; common fine and medium gypsum crystals; common fine and medium irregularly shaped soft lime masses; violent effervescence; strongly alkaline; clear smooth boundary.

C1—32 to 47 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine pores; common fine threads of soft lime; violent effervescence; moderately alkaline; clear wavy boundary.

C2—47 to 60 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; common fine distinct brownish yellow (10YR 6/8) mottles; weak medium and coarse subangular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; few fine gypsum crystals; common fine irregularly shaped soft lime masses; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 36 inches and the depth to carbonates from 15 to 25 inches. The thickness of the A horizon combined with that of the E horizon is 6 to 15 inches. The depth to gypsum and other salts typically ranges from 16 to 30 inches; however, some pedons are saline in the A and E horizons.

The Ap horizon has value of 4 or 5 (2 or 3 moist). The E horizon has value of 5 or 6 (3 or 4 moist). It is silt loam or loam. In some cultivated areas, it is mixed with the Ap horizon. The Bt horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is clay or silty clay. The C horizon is clay loam, silty clay loam, silty clay, clay, or silt loam. It is stratified in some pedons. Some pedons have weathered shale at a depth of 40 to 60 inches. Others are not mottled in the C2 horizon.

The Daglum soil in the Sinnigam-Daglum complex, 1 to 25 percent slopes, is a taxadjunct because it does not have a mollic epipedon and has shale at a depth of about 34 inches. These differences, however, do not alter the usefulness or behavior of the soil.

Dimmick Series

The Dimmick series consists of deep, very poorly drained, very slowly permeable soils in basins on uplands. These soils formed in clayey sediments. Slope is 0 to 1 percent.

Typical pedon of Dimmick silty clay, 75 feet north and 2,180 feet west of the southeast corner of sec. 25, T. 131 N., R. 98 W.

A1—0 to 4 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; common fine prominent dark yellowish brown (10YR 4/4) mottles; moderate fine granular and strong very fine angular blocky structure; hard, firm, very sticky and very plastic; many fine and few medium roots; many fine pores; 1/8- to 3/4-inch layer of partly decomposed stems and leaves at the surface; slightly acid; abrupt wavy boundary.

A2—4 to 22 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; common fine distinct dark yellowish brown (10YR 3/4) mottles; weak coarse prismatic structure parting to moderate medium and fine angular blocky; very hard, very firm, very sticky and very plastic; common fine and few medium roots; many fine pores; gray (10YR 5/1) coatings on the upper part of prisms; mildly alkaline; gradual wavy boundary.

Cg1—22 to 32 inches; gray (5Y 5/1) silty clay, dark gray (5Y 4/1) moist; few fine prominent dark yellowish brown (10YR 3/4) mottles; weak coarse prismatic structure parting to moderate fine angular blocky; very hard, very firm, very sticky and very plastic; few fine and few medium roots; many fine pores; moderately alkaline; gradual wavy boundary.

Cg2—32 to 60 inches; olive gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; few fine prominent dark yellowish brown (10YR 3/4) mottles; weak coarse prismatic structure parting to moderate fine angular blocky; very hard, very firm, very sticky and very plastic; few fine roots; few fine pores; few fine gypsum crystals in the lower part; slight effervescence in the lower part; moderately alkaline.

The depth to carbonates ranges from 25 to 50 inches. The mollic epipedon ranges from 15 to 24 inches in thickness. The soils have few to many mottles.

The A horizon has hue of 10YR, 2.5Y, or 5Y. Some pedons have an Oe horizon, which is 1 to 4 inches thick. The Cg horizon is dominantly clay or silty clay, but in some pedons it has strata of silty clay loam or sandy clay loam in the lower part.

Ekalaka Series

The Ekalaka series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in alluvium or in material weathered from soft bedrock. Slope ranges from 1 to 6 percent.

Typical pedon of Ekalaka fine sandy loam, 1 to 6 percent slopes, 2,340 feet east and 75 feet north of the southwest corner of sec. 24, T. 131 N., R. 91 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky and weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and common medium roots; many very fine and common medium pores; slightly acid; clear smooth boundary.

A2—5 to 12 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many very fine pores; slightly acid; clear smooth boundary.

E—12 to 17 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak very coarse prismatic structure parting to weak very thick platy; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many very fine pores; slightly acid; abrupt wavy boundary.

Bt1—17 to 20 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; strong very coarse columnar structure; extremely hard, firm, slightly sticky and slightly plastic; many very fine roots along faces of prisms; common very fine pores on the tops of columns; common faint clay films on faces of peds; light brownish gray (10YR 6/2) coatings on the tops of columns; moderately alkaline; clear wavy boundary.

Bt2—20 to 24 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; strong coarse and very coarse prismatic structure parting to moderate coarse subangular blocky; extremely hard, firm, slightly sticky and slightly plastic; common very fine roots along faces of prisms; common very fine pores; common faint clay films on faces of prisms; moderately alkaline; clear smooth boundary.

By—24 to 37 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; moderate coarse prismatic structure parting to weak medium and coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine pores; common fine gypsum crystals; few fine threads of soft lime; slight effervescence; strongly alkaline; gradual wavy boundary.

Bky—37 to 45 inches; light yellowish brown (2.5Y 6/4) loam, olive brown (2.5Y 4/4) moist; moderate fine subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine roots; common very fine pores; iron stains, reddish yellow (7.5YR 7/8) moist; few fine gypsum crystals; many medium irregularly shaped soft lime masses; violent effervescence; strongly alkaline; clear wavy boundary.

Cr—45 to 60 inches; grayish brown (2.5Y 5/2) and light gray (2.5Y 7/2) stratified weathered soft sandstone bedrock, dark grayish brown (2.5Y 4/2) and light brownish gray (2.5Y 6/2) moist.

The mollic epipedon is 7 to 20 inches thick. The depth to carbonates ranges from 15 to 30 inches. The depth to soft sandstone bedrock ranges from 40 to more than 60 inches.

The A1 horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. The E horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 1 or 2. It is loamy fine sand or fine sandy loam. The Bt horizon has hue of 10YR, 2.5Y, or 5Y. It is loam, fine sandy loam, or sandy loam. Some pedons do not have a Cr horizon.

Flasher Series

The Flasher series consists of shallow, somewhat excessively drained, rapidly permeable soils on uplands. These soils formed in material weathered from soft sandstone. Slope ranges from 3 to 70 percent.

Typical pedon of Flasher loamy fine sand, in an area of Beisigl-Flasher loamy fine sands, 6 to 20 percent slopes, 1,410 feet south and 700 feet west of the northeast corner of sec. 15, T. 129 N., R. 92 W.

A—0 to 3 inches; grayish brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; about 2 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

AC—3 to 10 inches; light olive brown (2.5Y 5/4) loamy fine sand, olive brown (2.5Y 4/4) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine pores; about 2 percent sandstone channers; slight effervescence; moderately alkaline; clear smooth boundary.

C1—10 to 13 inches; light olive brown (2.5Y 5/4) loamy fine sand, olive brown (2.5Y 4/4) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots; many fine pores; about 10 percent sandstone channers more than 0.75 inch in size; violent effervescence; moderately alkaline; clear smooth boundary.

C2—13 to 17 inches; grayish brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine pores; about 2 percent sandstone channers; moderately alkaline; abrupt wavy boundary.

Cr—17 to 60 inches; light yellowish brown (2.5Y 6/4) soft sandstone bedrock, olive brown (2.5Y 4/4) moist.

The depth to soft sandstone bedrock ranges from 7 to 20 inches. The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 (2 to 4 moist), and chroma of 2 or 3. It is fine sandy loam or loamy fine sand. The C horizon has hue of 2.5Y or 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loamy fine sand, loamy sand, or fine sand. The Cr horizon crushes to fine sand or loamy fine sand.

Grail Series

The Grail series consists of deep, well drained, slowly permeable soils on terraces and uplands. These soils formed in alluvium. Slope ranges from 1 to 3 percent.

Typical pedon of Grail clay loam, 1 to 3 percent slopes, 2,080 feet east and 1,340 feet north of the southwest corner of sec. 26, T. 129 N., R. 94 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, friable, sticky and plastic; many very fine roots; many very fine pores; slightly acid; abrupt smooth boundary.

A—5 to 9 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; many very fine roots; many very fine pores; slightly acid; clear smooth boundary.

Bt1—9 to 13 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to moderate fine subangular and angular blocky; very hard, firm, very sticky and very plastic; many very fine roots; many very fine pores; many faint clay films on faces of peds; neutral; clear smooth boundary.

Bt2—13 to 22 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse subangular blocky structure parting to moderate fine and medium subangular blocky; very hard, firm, very sticky and very plastic; many very fine roots; many very fine pores; many faint clay films on faces of peds; few fine threads of soft lime; slight effervescence; moderately alkaline; clear wavy boundary.

Bk1—22 to 27 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure parting to weak medium and fine subangular blocky; hard, firm, sticky and plastic; common very fine roots; common very fine pores; few fine soft lime masses; strong effervescence; moderately alkaline; clear wavy boundary.

Bk2—27 to 36 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine pores; many fine soft lime masses; violent effervescence; mildly alkaline; gradual wavy boundary.

C1—36 to 47 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine pores; common fine and medium soft lime masses; violent effervescence; moderately alkaline; abrupt smooth boundary.

C2—47 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; common very fine pores; common fine and medium soft lime masses; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to more than 40 inches. The depth to carbonates is 12 to 35 inches. The mollic epipedon ranges from 16 to 40 inches in thickness. Some pedons have a buried A horizon.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. The Bt2 horizon has value of 4 or 5. It is clay or silty clay. The C horizon ranges from loam to clay.

Harriet Series

The Harriet series consists of deep, poorly drained, very slowly permeable, alkali and saline soils on flood plains. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Harriet loam, 2,310 feet west and 100 feet north of the southeast corner of sec. 29, T. 130 N., R. 96 W.

Ez—0 to 3 inches; gray (10YR 6/1) loam, very dark gray (10YR 3/1) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure parting to weak thin platy; slightly hard, friable, slightly sticky and slightly plastic; many fine and common medium roots; many fine pores; few fine salt crystals; moderately alkaline; abrupt wavy boundary.

Btz1—3 to 9 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; gray (10YR 6/1) coatings on tops of columns; strong medium and coarse columnar structure parting to strong fine and very fine angular blocky; extremely hard, very firm, very sticky and very plastic; many fine roots pressed along faces of peds; common fine pores; common faint clay films on faces of peds; common fine salt crystals; few fine threads of soft lime; slight effervescence in the lower part; strongly alkaline; clear smooth boundary.

Btz2—9 to 16 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate fine and medium subangular blocky; extremely hard, very firm, very sticky and very plastic; common fine roots; many fine and very fine pores; common faint clay films on faces of peds; few fine salt crystals; few fine and medium soft lime masses; strong effervescence; strongly alkaline; clear smooth boundary.

Bkz—16 to 30 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak very coarse prismatic structure parting to moderate fine and medium subangular blocky; very hard, very firm, very sticky and very plastic; few very fine roots; many fine and very fine pores; few thin clay films on faces of peds; few fine salt crystals; few fine soft lime masses; violent effervescence; strongly alkaline; clear smooth boundary.

Bky—30 to 46 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few fine distinct brownish yellow (10YR 6/8) and olive gray (5Y 5/2) mottles; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; 1-inch-thick, very dark grayish brown (2.5Y 3/2) buried layer at a depth of 37 inches; few fine and medium soft lime masses; common nests of gypsum crystals; violent effervescence; strongly alkaline; clear smooth boundary.

Cy—46 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct brownish yellow (10YR 6/8) and olive gray (5Y 5/2) mottles; weak fine subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; many nests of gypsum crystals; strong effervescence; strongly alkaline.

The thickness of the solum ranges from 18 to 50 inches. The depth to carbonates is 5 to 10 inches. Visible salts are within a depth of 10 inches.

The B horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 to 4 moist), and chroma of 1 or 2. It is clay, silty clay loam, clay loam, or silty clay. The C horizon has hue of 2.5Y or 5Y. It has few to many mottles. It is dominantly clay, clay loam, or silty clay loam. In some pedons, however, it is stratified with coarser textured material.

Heil Series

The Heil series consists of deep, poorly drained, very slowly permeable, alkali soils in depressions on uplands. These soils formed in alluvium. Slope is 0 to 1 percent.

Typical pedon of Heil silt loam, 925 feet south and 25 feet east of the northwest corner of sec. 16, T. 132 N., R. 98 W.

E—0 to 4 inches; gray (10YR 6/1) silt loam, black (10YR 2/1) moist; common fine distinct dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky and weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine pores; slightly acid; abrupt smooth boundary.

Bt1—4 to 10 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; strong medium and coarse prismatic structure parting to strong fine and very fine angular blocky; extremely hard, very firm, very sticky and very plastic; common fine and very fine roots along faces of peds; common very fine pores; many faint clay films on faces of peds; moderately alkaline; clear smooth boundary.

Bt2—10 to 20 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; strong medium and coarse prismatic structure parting to strong fine and very fine angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine roots along faces of peds; common faint clay films on faces of peds; common very fine pores; moderately alkaline; clear smooth boundary.

Bky—20 to 36 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; extremely hard, very firm, very sticky and very plastic; few very fine roots; common fine pores; few fine gypsum crystals; few fine soft lime masses; strong effervescence; moderately alkaline; clear smooth boundary.

Cyg—36 to 60 inches; olive gray (5Y 5/2) silty clay, olive gray (5Y 4/2) moist; weak coarse prismatic structure; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; common fine gypsum crystals; few fine soft lime masses; strong effervescence; strongly alkaline.

The depth to carbonates ranges from 15 to 40 inches. The thickness of the solum ranges from 20 to 42 inches.

Some pedons have a black or very dark brown A1 horizon, which is 1 to 3 inches thick. The E horizon has value of 2 to 4 moist. The Bt horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. It is silty clay or clay. The Cyg horizon is silty clay, silty clay loam, or clay loam. In some pedons the content of gravel is as much as 5 percent.

Korchea Series

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

Typical pedon of Korchea loam, 150 feet west and 1,285 feet north of the southeast corner of sec. 30, T. 130 N., R. 92 W.

A—0 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; few thin strata of fine sandy loam in the lower part; slight effervescence; mildly alkaline; abrupt smooth boundary.

C—9 to 24 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; few fine strata of fine sandy loam, very dark brown (10YR 2/2) moist; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ab—24 to 35 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; strong effervescence; moderately alkaline; abrupt smooth boundary.

C'—35 to 60 inches; grayish brown (10YR 5/2) stratified loam and fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; moderately alkaline; violent effervescence.

The soils typically contain carbonates throughout but in some pedons do not have carbonates in the A horizon. Some pedons do not have a buried A horizon.

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

Lawther Series

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

Typical pedon of Lawther silty clay, 1 to 3 percent slopes, 2,195 feet south and 1,440 feet east of the northwest corner of sec. 25, T. 131 N., R. 98 W.

Ap—0 to 4 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak medium and coarse subangular blocky structure parting to moderate medium granular; very hard, firm, sticky and very plastic; common very fine pores; mildly alkaline; abrupt smooth boundary.

A—4 to 10 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse subangular blocky structure; very hard, very firm, sticky and very plastic; common very fine roots; common very fine pores; mildly alkaline; clear wavy boundary.

Bw1—10 to 21 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; very hard, firm, very sticky and very plastic; common very fine roots; common very fine pores; coatings on peds, very dark grayish brown (2.5Y 3/2) moist; tongues of A horizon 1 inch wide; distinct pressure faces; mildly alkaline; gradual wavy boundary.

Bw2—21 to 33 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium subangular blocky structure parting to moderate fine subangular blocky; very hard, firm, very sticky and very plastic; few very fine roots; common very fine pores; tongues of A horizon 0.5 inch wide; distinct pressure faces; few medium irregularly shaped soft lime masses; moderately alkaline; strong effervescence; clear wavy boundary.

Bk—33 to 47 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine pores; tongues of A horizon 0.5 inch wide; distinct pressure faces; common fine irregularly shaped soft lime masses; strong effervescence; moderately alkaline; abrupt wavy boundary.

C—47 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; very hard, firm, very sticky and very plastic; few very fine roots; many very fine pores; common fine irregularly shaped soft lime masses; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to more than 50 inches. The depth to free carbonates ranges from 0 to 30 inches. The thickness of the mollic epipedon is 7 to more than 24 inches. When dry, the soils have cracks that are as much as 2 inches wide and extend through the solum.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The Bw horizon has hue of 2.5Y or 5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is silty clay or clay. The C horizon has hue of 5Y or 2.5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is silty clay, clay, or clay loam and in some pedons is stratified in the lower part. Some pedons have fine crystals of gypsum in the lower part of the B horizon and in the C horizon.

Lihen Series

The Lihen series consists of deep, well drained, rapidly permeable soils on uplands. These soils formed in alluvium or eolian sediments. Slope ranges from 1 to 15 percent.

Typical pedon of Lihen loamy fine sand, 1 to 6 percent slopes, 1,360 feet south and 100 feet west of the northeast corner of sec. 15, T. 129 N., R. 92 W.

A1—0 to 7 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine pores; about 1 percent gravel; neutral; clear smooth boundary.

A2—7 to 11 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine pores; about 1 percent gravel; neutral; clear smooth boundary.

A3—11 to 18 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; weak coarse and medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine pores; about 1 percent gravel; neutral; clear smooth boundary.

Bk1—18 to 30 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine pores; about 1 percent gravel; lime disseminated throughout; strong effervescence; moderately alkaline; gradual smooth boundary.

Bk2—30 to 45 inches; light olive brown (2.5Y 5/4) fine sandy loam, olive brown (2.5Y 4/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; soft, very friable, nonsticky and nonplastic; few very fine roots; common very fine pores; about 1 percent gravel; lime disseminated throughout; strong effervescence; moderately alkaline; gradual smooth boundary.

C—45 to 60 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; few very fine pores; about 1 percent gravel; lime disseminated throughout; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 32 inches. The depth to carbonates ranges from 10 to 45 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. Some pedons have an AB horizon. The C horizon has value of 4 to 7 (3 to 6 moist) and chroma of 2 to 4.

Moreau Series

The Moreau series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from soft bedrock. Slope ranges from 3 to 6 percent.

These soils do not have a mollic epipedon, which is definitive for the Moreau series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Moreau silty clay, 3 to 6 percent slopes, 200 feet east and 2,570 feet north of the southwest corner of sec. 25, T. 131 N., R. 98 W.

Ap—0 to 4 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; very hard, firm, very sticky and very plastic; common very fine roots; common very fine pores; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bw—4 to 15 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to moderate fine angular and subangular blocky; very hard, firm, very sticky and very plastic; common very fine roots; many very fine pores; tongues of A horizon 0.5 inch wide; distinct pressure faces; strong effervescence; mildly alkaline; clear smooth boundary.

Bk—15 to 21 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to moderate fine angular and subangular blocky; very hard, firm, very sticky and very plastic; common very fine roots; many very fine pores; tongues of A horizon 0.5 inch wide; distinct pressure faces; common fine and medium irregularly shaped soft lime masses; strong effervescence; mildly alkaline; clear smooth boundary.

Bky—21 to 28 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; weak coarse prismatic structure parting to moderate fine angular and subangular blocky; very hard, firm, very sticky and very plastic; many very fine roots; many very fine pores; tongues of A horizon about 0.5 inch wide; distinct pressure faces; few fine gypsum crystals; many fine and medium irregularly shaped soft lime masses; violent effervescence; mildly alkaline; clear wavy boundary.

Cy—28 to 34 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; moderate fine angular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; few very fine pores; common small fragments of unweathered shale; few distinct pressure faces; many fine gypsum crystals; many fine and medium soft lime masses; strong effervescence; mildly alkaline; gradual wavy boundary.

Cr—34 to 60 inches; light gray (5Y 7/2) and pale yellow (5Y 7/3) shale bedrock, olive gray (5Y 5/2) and olive (5Y 5/3) moist.

The depth to soft shale bedrock ranges from 20 to 40 inches. The thickness of the solum ranges from 15 to 35 inches.

The A horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 to 4. The Bw horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 to 4. It is silty clay or clay. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4.

Parshall Series

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

Typical pedon of Parshall fine sandy loam, 1 to 6 percent slopes, 1,390 feet east and 1,250 feet south of the northwest corner of sec. 15, T. 129 N., R. 93 W.

A—0 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; many fine pores; neutral; gradual wavy boundary.

Bw—10 to 28 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common fine roots; many fine pores; very few thin clay films on faces of peds; neutral; clear wavy boundary.

Bk—28 to 35 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse and medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; common fine pores; few fine soft lime masses; strong effervescence; moderately alkaline; clear smooth boundary.

C—35 to 60 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots in the upper part; common fine pores; lime disseminated throughout; violent effervescence; moderately alkaline.

The depth to carbonates ranges from 20 to 35 inches. The mollic epipedon includes all or part of the Bw horizon. Some pedons have dark buried layers at a depth of 40 to 60 inches. Some pedons are saline.

The A horizon has value of 3 to 5 (2 or 3 moist). The Bw horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. The Bk horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 to 4. It is fine sandy loam or loamy fine sand. Some pedons have sand and gravel at a depth of 50 to 60 inches. The content of gravel is 2 to 5 percent throughout some pedons.

Regan Series

The Regan series consists of deep, poorly drained, moderately permeable soils on uplands. These soils formed in alluvium. Slope ranges from 0 to 3 percent.

These soils contain more sand in the upper part of the solum than is definitive for the Regan series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Regan silt loam, 0 to 3 percent slopes, 2,375 feet west and 400 feet south of the northeast corner of sec. 19, T. 129 N., R. 93 W.

Az—0 to 7 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) silt loam, very dark gray (10YR 3/1) and black (10YR 2/1) moist; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and common medium roots; many very fine pores; few fine salt crystals; strong effervescence; mildly alkaline; abrupt wavy boundary.

ABkz—7 to 10 inches; gray (10YR 5/1) loam, dark gray (10YR 4/1) moist; moderate medium and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; many very fine pores; very dark gray (10YR 3/1) coatings; few fine salt crystals; common fine irregularly shaped soft lime masses; violent effervescence; moderately alkaline; clear irregular boundary.

Bk1—10 to 16 inches; gray (10YR 6/1) and light gray (10YR 7/1) clay loam, gray (10YR 5/1 and 6/1) moist; weak very coarse prismatic structure parting to weak medium and coarse subangular blocky; hard, friable, sticky and plastic; many very fine and common medium roots; many very fine pores; coatings of dark gray (10YR 4/1); few large generally rounded soft lime masses; violent effervescence; moderately alkaline; clear irregular boundary.

Bk2—16 to 20 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; few fine distinct brownish yellow (10YR 6/8) mottles; weak very coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and common medium roots; many very fine pores; common medium generally rounded soft lime masses; violent effervescence; moderately alkaline; clear smooth boundary.

C1—20 to 40 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; few fine distinct brownish yellow (10YR 6/8) and few fine faint gray (10YR 6/1) mottles; weak very coarse prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common medium roots; many very fine pores; strong effervescence; moderately alkaline; clear smooth boundary.

C2—40 to 48 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; common fine prominent yellow (10YR 7/8) and dark yellowish brown (10YR 4/6) and few fine distinct gray (5Y 5/1) mottles; weak very coarse prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; many very fine roots; many very fine pores; few fine salt crystals; few fine irregularly shaped soft lime masses; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg1—48 to 54 inches; light gray (5Y 6/1) sandy clay loam, gray (5Y 5/1) moist; common fine prominent yellow and dark yellowish brown (10YR 7/8 and 4/6) mottles; weak coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine pores; few fine salt crystals; few fine irregularly shaped soft lime masses; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg2—54 to 60 inches; gray (5Y 5/1) clay loam, dark gray (5Y 4/1) moist; common fine prominent yellow and dark yellowish brown (10YR 7/8 and 4/6) mottles; weak coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine pores; few snail shell fragments; few fine irregularly shaped soft lime masses; few fine salt crystals; moderately alkaline; strong effervescence.

The mollic epipedon is 7 to 15 inches thick. The control section averages more than 15 percent fine sand or coarser sand and has a clay content of 18 to 35 percent.

The A horizon has hue of 10YR or 2.5Y and value of 3 to 5 (2 or 3 moist). The Bk horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. It has value of 4 to 6 (5 to 8 dry) and chroma of 0 to 2. It is loam, silt loam, clay loam, or silty clay loam. The Cg horizon has hue of 2.5Y or 5Y. It has few to many mottles. It is sandy clay loam, clay loam, fine sandy loam, loam, silty clay loam, or clay.

Regent Series

The Regent series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from soft bedrock. Slope ranges from 3 to 9 percent.

Typical pedon of Regent silty clay loam, 3 to 6 percent slopes, 2,590 feet west and 2,040 feet north of the southeast corner of sec. 31, T. 129 N., R. 93 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky and moderate very fine granular structure; very hard, firm, sticky and plastic; common fine roots; many fine pores; neutral; abrupt smooth boundary.

Bt1—7 to 12 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to strong fine angular blocky; very hard, firm, very sticky and very plastic; common fine roots; many fine pores; many faint clay films; mildly alkaline; gradual wavy boundary.

Bt2—12 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common fine roots; many fine pores; many faint clay films on faces of peds; few medium soft lime masses; slight effervescence; mildly alkaline; gradual wavy boundary.

Bk1—22 to 31 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common fine roots; common fine pores; few thin clay films on faces of peds; common fine strong brown (7.5YR 5/6) iron stains; many fine and medium soft lime masses; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk2—31 to 36 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak coarse and medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; common fine pores; common fine strong brown (7.5YR 5/6) iron stains; few shale fragments; common fine and medium soft lime masses; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—36 to 60 inches; olive (5Y 5/3) soft shale bedrock, olive (5Y 4/3) moist.

The depth to soft shale bedrock typically is 30 to 40 inches but ranges from 20 to 40 inches. The mollic epipedon is 7 to 16 inches thick. The depth to free carbonates is 10 to 25 inches. The thickness of the solum ranges from 15 to 40 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bt horizon has value of 4 or 5 (3 or 4 moist). It is silty clay, clay, or silty clay loam. The Bk horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is silty clay loam or silty clay. The Cr horizon is soft shale that crushes to silty clay loam or silty clay.

The Regent soil in the Regent-Cabba complex, 6 to 9 percent slopes, is a taxadjunct because it does not have an argillic horizon and has carbonates within a depth of 10 inches. These differences, however, do not alter the usefulness or behavior of the soil.

Rhoades Series

The Rhoades series consists of deep, well drained and moderately well drained, very slowly permeable, alkali soils on uplands. These soils formed in material weathered from soft bedrock or in alluvium. Slope ranges from 1 to 6 percent.

Typical pedon of Rhoades silt loam, in an area of Rhoades-Daglum silt loams, 1 to 6 percent slopes, 125 feet east and 350 feet south of the northwest corner of sec. 16, T. 131 N., R. 96 W.

E—0 to 3 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate thin and medium platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine and few coarse roots; common fine and few coarse pores; slightly acid; abrupt smooth boundary.

Bt—3 to 8 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; strong medium columnar structure parting to strong fine and very fine angular blocky; extremely hard, very firm, very sticky and very plastic; common fine roots, most along faces of peds; common fine pores; many faint clay films on faces of peds; light brownish gray (10YR 6/2) coatings on the tops of columns; moderately alkaline; clear wavy boundary.

Btyz—8 to 14 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to moderate fine angular blocky; very hard, very firm, very sticky and very plastic; common fine roots along faces of peds; common fine pores; common faint clay films on faces of peds; common fine flecks of gypsum and other salt crystals; few fine soft lime masses; strong effervescence; strongly alkaline; gradual wavy boundary.

Byz—14 to 24 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky and very plastic; common fine roots; common fine pores; few thin clay films on faces of peds; common fine flecks of gypsum and other salt crystals; few fine soft lime masses; strong effervescence; strongly alkaline; gradual wavy boundary.

By1—24 to 40 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; very hard, very firm, very sticky and very plastic; few fine roots; common fine pores; common fine gypsum accumulations; common fine soft lime masses; strong effervescence; strongly alkaline; gradual wavy boundary.

By2—40 to 46 inches; light yellowish brown (2.5Y 6/4) silty clay, light olive brown (2.5Y 5/4) moist; few fine prominent strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; hard, firm, very sticky and very plastic; few fine pores; few fine gypsum accumulations; common fine soft lime masses; strong effervescence; strongly alkaline; clear wavy boundary.

C—46 to 60 inches; pale yellow (2.5Y 7/4) stratified silt loam and silty clay loam, light yellowish brown (2.5Y 6/4) moist; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, sticky and plastic; few fine soft lime masses; violent effervescence; strongly alkaline.

The thickness of the solum ranges from 16 to 46 inches. The depth to carbonates ranges from 7 to 20 inches. Gypsum and other salt crystals are within a depth of 16 inches.

Some pedons have a thin A horizon. The thickness of the A horizon combined with that of the E horizon is less than 5 inches. The E horizon has value of 4 to 6 (3 to 5 moist). The Bt horizon has hue of 2.5Y or 10YR and value of 2 or 3 when moist. It is silty clay, clay, silty clay loam, or clay loam. The C horizon has hue of 2.5Y or 5Y. It is silty clay loam, silty clay, clay loam, loam, or silt loam. Some pedons have soft shale at a depth of 40 to 60 inches.

Ruso Series

The Ruso series consists of deep, well drained soils on terraces. These soils formed in loamy alluvium that is moderately deep over sand and gravel. Permeability is moderately rapid in the upper part of the profile and very rapid in the lower part. Slope ranges from 1 to 3 percent.

Typical pedon of Ruso fine sandy loam, 1 to 3 percent slopes, 2,225 feet north and 385 feet east of the southwest corner of sec. 15, T. 129 N., R. 93 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; about 5 percent gravel; neutral; abrupt smooth boundary.

A—6 to 10 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; about 5 percent gravel; neutral; clear smooth boundary.

Bw1—10 to 24 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; about 5 percent gravel; neutral; gradual wavy boundary.

2Bw2—24 to 29 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak coarse prismatic structure; soft, very friable, slightly sticky and nonplastic; common very fine roots; about 10 percent gravel; neutral; gradual wavy boundary.

2C—29 to 60 inches; light brownish gray (10YR 6/2) gravelly sand, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; about 35 percent gravel; strong effervescence; mildly alkaline.

The depth to carbonates is 20 to 35 inches. The depth to sand or to sand and gravel ranges from 20 to 40 inches. The mollic epipedon ranges from 16 to 30 inches in thickness.

The A horizon has value of 3 to 5 (2 or 3 moist). The Bw horizon has hue of 2.5YR or 10YR, value of 3 to 5 (2 to 4 moist), and chroma of 2 or 3. The C horizon is loamy sand, sand, gravelly sand, or very gravelly sand.

Savage Series

The Savage series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in alluvium. Slope ranges from 1 to 15 percent.

Typical pedon of Savage clay loam, 3 to 6 percent slopes, 265 feet north and 700 feet west of the southeast corner of sec. 3, T. 130 N., R. 94 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to moderate fine granular; hard, friable, sticky and plastic; many very fine roots; many very fine pores; neutral; abrupt smooth boundary.

Bt1—6 to 11 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, firm, very sticky and very plastic; many very fine roots; many very fine pores; many faint clay films on faces of peds; neutral; clear smooth boundary.

Bt2—11 to 15 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, firm, very sticky and very plastic; common very fine roots; many very fine pores; many faint clay films on faces of peds; mildly alkaline; clear wavy boundary.

Bk1—15 to 21 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, sticky and plastic; common very fine roots; common very fine pores; common fine generally rounded soft lime masses; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk2—21 to 36 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine pores; common fine generally rounded soft lime masses; violent effervescence; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; light brownish gray (2.5Y 6/2) and light yellowish brown (2.5Y 6/4) clay loam, dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine pores; common fine generally rounded soft lime masses; violent effervescence; moderately alkaline.

The solum ranges from 15 to 40 inches in thickness. The mollic epipedon is 7 to 16 inches thick. The depth to free carbonates ranges from 10 to 25 inches.

The A horizon has value of 4 or 5 (2 or 3 moist). It is clay loam or silt loam. The Bt horizon has chroma of 2 to 4. It is clay, silty clay loam, clay loam, or silty clay. The C horizon is clay loam, silty clay loam, loam, or silt loam.

Sen Series

The Sen series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft bedrock. Slope ranges from 3 to 6 percent.

Typical pedon of Sen silt loam, 3 to 6 percent slopes, 600 feet east and 50 feet south of the northwest corner of sec. 12, T. 130 N., R. 97 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate very fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common medium roots; many very fine and common medium pores; neutral; abrupt smooth boundary.

Bw1—6 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common medium roots; many very fine and common medium pores; mildly alkaline; clear smooth boundary.

Bw2—12 to 15 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; mildly alkaline; clear smooth boundary.

Bk1—15 to 21 inches; light brownish gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; weak very coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; lime disseminated throughout; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—21 to 33 inches; pale yellow (2.5Y 7/4) silty clay loam, light yellowish brown (2.5Y 6/4) moist; weak very coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; few unweathered shale fragments; few fine gypsum crystals in the lower part; violent effervescence; moderately alkaline; gradual smooth boundary.

Cr—33 to 60 inches; light gray (5Y 7/2) stratified soft siltstone bedrock, light olive gray (5Y 6/2) moist.

The depth to carbonates is 10 to 20 inches. The mollic epipedon is 7 to 16 inches thick. The thickness of the solum ranges from 18 to 40 inches and the depth to soft siltstone bedrock from 20 to 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is silt loam, loam, or silty clay loam. The Bk horizon has value of 5 to 8 (4 to 6 moist) and chroma of 2 to 4. It is silty clay loam or silt loam. The Cr horizon is siltstone or shale that crushes to silt loam or silty clay loam.

Shambo Series

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

Typical pedon of Shambo loam, 3 to 6 percent slopes, 135 feet south and 1,585 feet west of the northeast corner of sec. 33, T. 129 N., R. 91 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak coarse and medium subangular blocky structure parting to moderate fine granular; hard, friable, slightly sticky and slightly plastic; many very fine roots; common fine pores; neutral; abrupt smooth boundary.

A—6 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak thin platy; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; very dark brown (10YR 2/2) organic coatings on faces of peds; about 5 percent gravel; neutral; abrupt wavy boundary.

Bw1—9 to 12 inches; brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; many fine roots; many fine pores; many thin clay films on faces of peds; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bw2—12 to 25 inches; grayish brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; many very fine roots; many fine pores; many thin clay films on faces of peds; very dark grayish brown (10YR 3/2) organic coatings on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bw3—25 to 30 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; common very fine roots; common fine pores; few thin clay films on faces of peds; about 10 percent gravel; mildly alkaline; abrupt wavy boundary.

Bk—30 to 41 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; common very fine roots; common very fine pores; many fine soft lime masses; violent effervescence; moderately alkaline; gradual wavy boundary.

C—41 to 60 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine pores; common fine soft lime masses; violent effervescence; moderately alkaline.

The depth to free carbonates and the thickness of the solum range from 15 to 32 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has value of 3 to 5 (2 or 3 moist). The Bw horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is loam, sandy clay loam, or clay loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is fine sandy loam, loam, gravelly loam, sandy loam, silt loam, silty clay loam, or clay loam. Some pedons have sand and gravel at a depth of 50 to 60 inches.

Sinnigam Series

The Sinnigam series consists of shallow, well drained, moderately slowly permeable soils on uplands. These soils formed in material weathered from hard bedrock. Slope ranges from 1 to 6 percent.

Typical pedon of Sinnigam very stony loam, in an area of Sinnigam-Daglum complex, 1 to 25 percent slopes, 1,815 feet west and 130 feet south of the northeast corner of sec. 19, T. 131 N., R. 93 W.

A—0 to 2 inches; grayish brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; about 25 percent channers; neutral; clear smooth boundary.

Bt1—2 to 6 inches; brown (10YR 4/3) very channery clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; few faint clay films on faces of peds; about 40 percent channers; neutral; clear smooth boundary.

Bt2—6 to 13 inches; brown (7.5YR 4/4) very channery clay, dark brown (7.5YR 3/4) moist; strong fine subangular blocky structure; hard, firm, sticky and plastic; many very fine roots, many matted at contact with fragments; many very fine pores; many faint clay films on faces of peds and fragments; about 55 percent channers; slight effervescence on undersides of fragments; neutral; abrupt smooth boundary.

R—13 to 24 inches; white (5Y 8/1) hard bedrock; vertical fractures 3 to more than 10 inches apart; roots matted at contact with rock; brown (7.5YR 4/4) fine earth material filling some fracture voids; slight effervescence on undersides of fragments.

The depth to lithic contact is 10 to 20 inches. The thickness of the mollic epipedon, after mixing, is 7 to 12 inches. The content of stones, channers, flagstones, or cobblestones is 15 to 40 percent in the A horizon and 20 to 60 percent in the Bt horizon.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bt horizon has value of 4 or 5 (3 or 4 moist). The fine earth material in this horizon is clay loam or clay.

Straw Series

The Straw series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in alluvium. Slope ranges from 0 to 3 percent.

Typical pedon of Straw loam, 0 to 3 percent slopes, 1,225 feet east and 50 feet south of the northwest corner of sec. 17, T. 129 N., R. 93 W.

A1—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; 1-inch-thick band of fine sandy loam at the surface; 2-inch-thick band that is very dark brown (10YR 2/2) when moist; weak medium and coarse subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common medium roots; many very fine pores; neutral; clear smooth boundary.

A2—9 to 18 inches; dark grayish brown (2.5Y 4/2) loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few medium roots; many very fine pores; neutral; clear smooth boundary.

C1—18 to 28 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; many very fine pores; common fine soft lime masses; violent effervescence; moderately alkaline; clear wavy boundary.

C2—28 to 56 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; very thin band at a depth of about 36 inches, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; few fine soft lime masses; violent effervescence; moderately alkaline; clear smooth boundary.

Ab—56 to 60 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine pores; few fine soft lime masses; violent effervescence; moderately alkaline.

The depth to carbonates generally is 10 to 25 inches, but some pedons are calcareous throughout. The thickness of the mollic epipedon ranges from 16 to 30 inches.

The A horizon has value of 3 to 5 (2 or 3 moist). Some pedons have a loam or silt loam B horizon. The C horizon has hue of 2.5Y or 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loam, silt loam, or fine sandy loam and commonly is stratified with coarser or finer textures.

Vebar Series

The Vebar series consists of moderately deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in material weathered from soft bedrock. Slope ranges from 1 to 9 percent.

Typical pedon of Vebar fine sandy loam, in an area of Vebar-Parshall fine sandy loams, 1 to 6 percent slopes, 460 feet west and 500 feet south of the northeast corner of sec. 36, T. 131 N., R. 98 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

Bw1—8 to 13 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate medium and coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; neutral; gradual wavy boundary.

Bw2—13 to 21 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak medium and coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine pores; mildly alkaline; gradual wavy boundary.

Bw3—21 to 29 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; soft, very friable, nonsticky and nonplastic; many fine roots; common fine pores; mildly alkaline; clear wavy boundary.

Bk—29 to 34 inches; light gray (2.5Y 7/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; weak very coarse prismatic structure parting to weak medium subangular blocky; soft, very friable, nonsticky and nonplastic; common fine roots; common fine pores; few fine soft lime masses; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—34 to 60 inches; light gray (2.5Y 7/2) soft sandstone bedrock, grayish brown (2.5Y 5/2) moist.

The mollic epipedon is 7 to 16 inches thick. The thickness of the solum and the depth to soft sandstone bedrock range from 20 to 40 inches.

The Ap horizon has value of 3 to 5 dry (2 or 3 moist). The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. Some pedons do not have a Bk horizon. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is loamy fine sand or fine sandy loam. The Cr horizon is soft sandstone that crushes to loamy fine sand, loamy sand, or fine sand.

Velva Series

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

Typical pedon of Velva fine sandy loam, 800 feet west and 1,140 feet south of the northeast corner of sec. 15, T. 131 N., R. 95 W.

A—0 to 4 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate fine and medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; slight effervescence; mildly alkaline; abrupt smooth boundary.

AC—4 to 9 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—9 to 14 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; thin band that is dark grayish brown (10YR 4/2) when moist; strong effervescence; moderately alkaline; clear smooth boundary.

C2—14 to 25 inches; grayish brown (2.5Y 5/2) fine sandy loam that has thin strata of loam; dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; thin bands that are very dark grayish brown (10YR 3/2) when moist; few fine irregularly shaped soft lime masses; violent effervescence; moderately alkaline; abrupt smooth boundary.

Aby—25 to 31 inches; very dark gray (10YR 3/1) fine sandy loam, black (10YR 2/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; thin band that is very dark grayish brown (10YR 3/2) when moist; few fine gypsum crystals; few fine irregularly shaped soft lime masses; strong effervescence; moderately alkaline; abrupt smooth boundary.

C'—31 to 60 inches; grayish brown (2.5Y 5/2) fine sandy loam that has thin strata of loam and loamy fine sand; dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; thin bands that are very dark grayish brown (10YR 3/2) when moist; few fine irregularly shaped soft lime masses; violent effervescence; moderately alkaline.

The mollic epipedon is 7 to 16 inches thick. The soils generally contain carbonates throughout, but some pedons do not have carbonates in the A horizon.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 4 to 7 (3 to 5 moist), and chroma of 2 to 4.

Watrous Series

The Watrous series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from hard bedrock. Slope ranges from 1 to 6 percent.

Typical pedon of Watrous loam, 1 to 6 percent slopes, 435 feet south and 200 feet west of the northeast corner of sec. 21, T. 129 N., R. 92 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate medium granular; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

Bt1—6 to 15 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium and coarse subangular blocky structure; hard, friable, sticky and plastic; common fine roots; many fine pores; few faint clay films on faces of peds; neutral; clear smooth boundary.

Bt2—15 to 27 inches; brown (10YR 5/3) channery clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to moderate fine angular blocky; hard, friable, sticky and plastic; common fine roots; many fine pores; few thin clay films on faces of peds; about 15 percent channers; mildly alkaline; abrupt smooth boundary.

R—27 to 33 inches; white (5Y 8/1) hard bedrock; vertical fractures 3 to more than 10 inches apart; roots matted at contact with rock; brown (10YR 5/3)

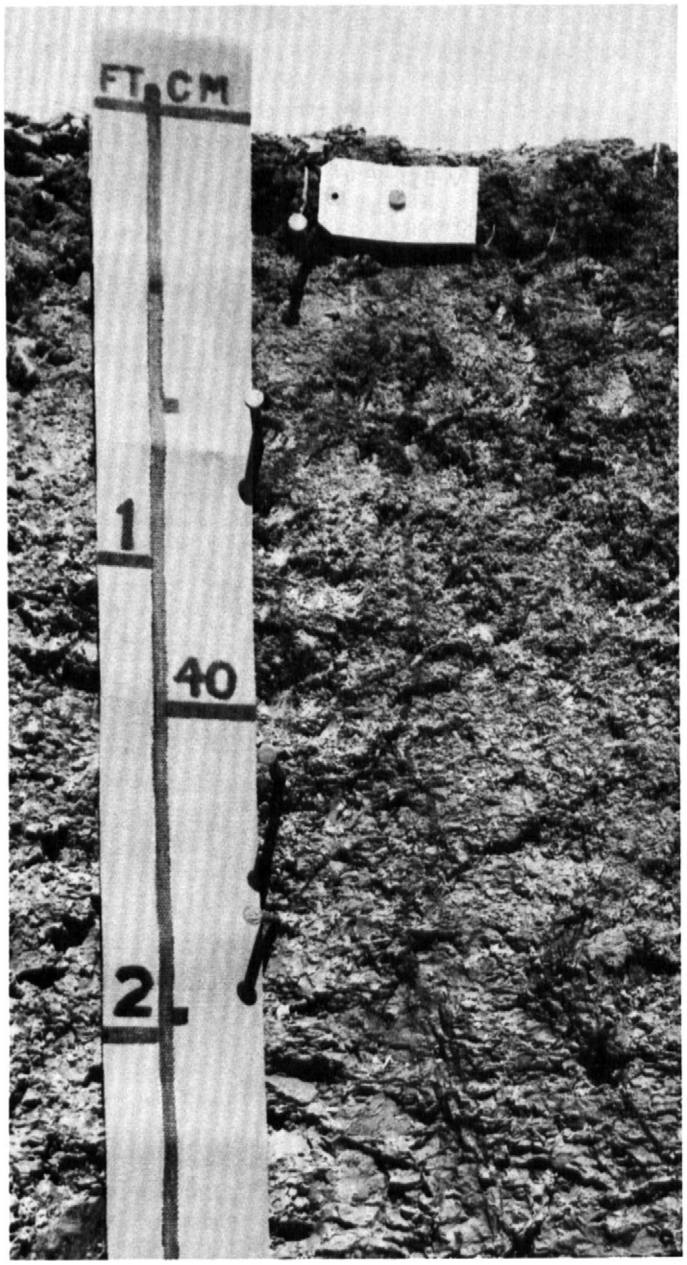


Figure 13.—Profile of Wayden silty clay, which is shallow over shale bedrock.

fine earth material filling some fracture voids; violent effervescence in thin seams.

The thickness of the solum and the depth to hard bedrock are 20 to 30 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. The B horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 to 4. It is clay loam, loam, or channery clay loam.

Wayden Series

The Wayden series consists of shallow, well drained, slowly permeable soils on uplands. These soils formed in material weathered from soft bedrock (fig. 13). Slope ranges from 2 to 9 percent.

Typical pedon of Wayden silty clay, 2 to 9 percent slopes, 300 feet east and 2,310 feet south of the northwest corner of sec. 25, T. 131 N., R. 98 W.

Ap—0 to 4 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong very fine granular structure; very hard, firm, very sticky and very plastic; common very fine roots; many very fine pores; slight effervescence; moderately alkaline; abrupt smooth boundary.

AC—4 to 9 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; moderate very fine subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; many very fine pores; tongues of A horizon 0.5 inch wide; common irregularly shaped soft lime masses; slight effervescence; moderately alkaline; clear wavy boundary.

Cy—9 to 18 inches; pale yellow (5Y 7/3) silty clay, olive (5Y 5/3) moist; moderate very fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine pores; common medium iron stains, yellowish brown (10YR 5/8) moist; about 30 percent shale fragments; common pressure faces; tongues of A horizon about 0.5 inch wide; common gypsum crystals; slight effervescence; moderately alkaline; clear wavy boundary.

Cr—18 to 60 inches; pale yellow (5Y 7/3) shale bedrock, olive (5Y 5/3) moist.

The depth to soft shale bedrock ranges from 10 to 20 inches. The A horizon has value of 5 or 6 (3 to 5 moist) and chroma of 2 to 4. The C horizon has hue of 5Y or 2.5Y, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 4. It is silty clay, silty clay loam, or clay. The Cr horizon is soft, platy shale that crushes to silty clay or clay.

Formation of the Soils

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. Soil characteristics are determined by the physical traits and chemical and mineralogical composition of the parent material; the climate under which the soil material accumulated and has existed since accumulation; the plant and animal life on and in the soil; relief; and the length of time that the processes of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are very influential factors of soil formation. They determine the nature of weathering and slowly change the parent material into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief and by the parent material. Finally, time is needed for the climatic and biological forces to weather the parent material and form a soil. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Climate

Climate is perhaps the most influential factor of soil formation. It affects the physical and chemical processes of weathering in the parent material and the biological activities in the soil. The processes of soil formation are most active if the climate is warm and moist. Climate influences these processes to a large extent through its effect on vegetation. Adams County has a continental, semiarid climate characterized by long, cold winters and short, warm summers. Most of the precipitation falls during the growing season. This climate favors the growth of mid and short grasses.

Moisture and temperature directly affect the weathering processes in the parent material. They also affect the leaching and redistribution of carbonates and clay particles and the accumulation of organic matter in the soil. Freezing and thawing help break down soil particles in the parent material, thereby providing more surface area for chemical processes. The cold and semiarid climate in the county prevents deep leaching and extensive chemical weathering. It also prevents large yields of vegetation, but it allows organic matter to accumulate in the soil.

Some soils in the county exhibit evidence of freezing in an earlier time. This evidence is the ice-wedge polygons that formed when the ground was permanently frozen (*5*). The polygonal patterns are evident in some areas of the Shambo soils, particularly northeast of North Lemmon. The plant growth pattern in some areas of these soils is the same as the pattern of alternating tall and short plants characteristic of sodium-affected soils, such as Belfield and Daglum soils.

Plant and Animal Life

Plants have significantly influenced the formation of soils in Adams County. Earthworms, small animals, and micro-organisms are also important but to a lesser extent.

The native vegetation consisted mostly of mid and short grasses. Plant roots act as agents in weathering the parent material both physically and chemically. Animals and micro-organisms break down the plant remains into humus, thus releasing plant nutrients. They also provide a medium whereby nutrients that have been leached into the lower part of the soil are brought back to the surface.

Time

Time is necessary for the processes of soil formation to act on parent material. The length of time needed for a particular soil to form depends on the other factors of soil formation.

The soils in Adams County range from mature to young. The mature soils have well expressed profile characteristics, whereas the young soils show little or no evidence of profile development. Soils on flood plains, such as Velva and Korchea soils, periodically receive new material when they are flooded. They are young because the fresh material has not been in place long enough for the formation of distinct horizons. The gently sloping soils in the uplands are older than those on the flood plains. The older soils have well defined horizons and a distinct structure in the subsoil. Regent and Sen soils are examples.

Relief

Relief, or lay of the land, influences soil formation mainly by controlling the movement of water. The effects of relief are modified by the four other factors of soil formation, especially climate and vegetation.

The profile of soils that formed in depressions differs from that of soils that formed on steep slopes. Heil and Dimmick soils, which formed in depressions that pond runoff, exhibit an advanced degree of horizonation and soil mottling because of the alternate wetting and drying cycles that occur in the depressions. Arnegard and other soils that formed in swales that receive runoff from the surrounding slopes have a thick surface layer. The content of organic matter is high in the surface layer because of the additional moisture and luxuriant plant growth.

The more gently sloping soils, such as Amor and Savage soils, generally have a more abundant plant cover than the steeper soils. Their horizons are better expressed, and lime has been leached to a greater depth. The steeper soils, such as Cabba and Flasher soils, exhibit a minimal degree of horizonation, have lime close to the surface, and are low in content of organic matter. Runoff is probably the most important factor in the formation of the steep, excessively drained soils. The droughtiness of these soils results in less plant cover, and a high runoff rate results in continued erosion. The limited plant cover and continued erosion restrict soil formation.

Parent Material

One of the most important physical properties of parent material is its texture. The texture of the parent material determines the texture of the soil, which is an important factor in the use and management of the soil. Other properties of the parent material also can have an important effect on soil formation. Rhoades, Daglum, and other soils that have a dense, alkali subsoil, for example, generally formed in parent material that contained an excess of sodium salts.

The parent materials of the soils in Adams County have several different origins. The most extensive parent material weathered from soft residual bedrock of the Tertiary Period. The major geological formation exposed in the county is the Fort Union Formation of Paleocene Age. This formation is subdivided into the Ludlow, Cannonball, Slope, Bullion Creek, and Sentinel Butte members (*8*). Except for the Cannonball member, the exposed bedrock in the county is of continental origin. It consists of sediments deposited by wind and water on the land and in freshwater lakes. The deeper sediments and the sediments of the Cannonball member were deposited in shallow saltwater seas.

The Fort Union Formation consists of stratified layers of soft sandstone, siltstone, shale, and lignite. Amor, Cabba, Flasher, Regent, Vebar, and Wayden are some of the soils that formed in material weathered from this formation. Arnegard, Parshall, and Straw soils formed in weathered alluvium that was transported from the areas of soft bedrock.

In a few areas the soils formed in porcelanite, locally called scoria. The porcelanite formed through the burning of lignite veins that baked the surrounding material. The resulting red rock is resistant to weathering. Brandenburg soils are an example of soils that formed in material weathered from porcelanite. The lignite beds of the various geological members have contributed little to the characteristics of the soils in the county.

The dense, alkali subsoil in Rhoades, Daglum, Heil, and Harriet soils formed when excess sodium salts were removed from the upper part of the profile. This process resulted in the leaching of clay and organic matter and the formation of a platy, gray subsurface layer. As the leaching process continued, a dense, clay- and sodium-rich subsoil formed through the movement and redeposition of the leached clay and organic matter.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Arnold, R.W. Clean brush approach achieves better concepts. (Unpublished)

(4) Berg, F.M., R.L. Boxrud, R. Plum, and J. Sailor. 1982. Our heritage—the first 75 years. North Plains Press, 48 pp., illus.

(5) Bluemle, John P., ed. 1982. Permafrost in southwestern North Dakota. N. Dak. Geol. Surv. Newsl., Dec. 1982, pp. 30-38, illus.

(6) Brown, Al, and Jim Krall. 1979. Saline seep handbook. Mont. State Univ., Coop. Ext. Serv. Bull. 1205, 13 pp., illus.

(7) Cairns, R.R., and W.E. Bowser. 1978. Solonetzic soils and their management. Can. Dep. Agric. Publ. 1391, 37 pp., illus.

(8) Carlson, C.G. 1979. Geology of Adams and Bowman Counties, North Dakota. N. Dak. Geol. Surv. Bull. 65, Part I, 29 pp., illus.

(9) Carver, Robert F., and William G. Hamlin. 1982. North Dakota agricultural statistics—1982. N. Dak. Crop and Livest. Rep. Serv. Agric. Stat. No. 50, 94 pp., illus.

(10) Croft, M.G. 1978. Ground-water resources of Adams and Bowman Counties, North Dakota. N. Dak. Geol. Surv. Bull. 65, Part II, and County Ground-Water Stud. 22, Part III, 54 pp., illus.

(11) Lapham, Macy H., and others. 1910. Soil survey of western North Dakota. U.S. Dep. Agric., Bur. of Soils, 80 pp., illus.

(12) Mausbach, M.J., E.E. Gamble, M.W. Meyer, and R.F. Paetzold. 1980. Characterization data for unsaturated hydraulic conductivity study. U.S. Dep. Agric., Soil Conserv. Serv., Natl. Soil Surv. Lab., Proj. Rep. CP78—ND060, 8 pp., illus.

(13) Omodt, H.W., G.A. Johnsgard, D.D. Patterson, and O.P. Olson. 1968. The major soils of North Dakota. N. Dak. State Univ., Agric. Exp. Stn. Bull. 472, 60 pp., illus.

(14) Patterson, D.D., G.A. Johnsgard, M.D. Sweeney, and H.W. Omodt. 1968. Soil survey report, county general soil maps, North Dakota. N. Dak. State Univ., Agric. Exp. Stn. Bull. 473, 150 pp., illus.

(15) Rice, Thomas D., Ray Babcock, and John T. Weaver. 1908. Soil survey of the Morton area, North Dakota. U.S. Dep. Agric., Bur. of Soils, 26 pp., illus.

(16) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(17) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(18) United States Department of Agriculture, Soil Conservation Service. 1981. Land resource regions and major land resource areas of the United States. Agric. Handb. 296, rev. ed., 156 pp., illus.

(19) Veigel, L.W., and Co., P.C. 1972. Comprehensive area-wide development plan for water, sewer and solid waste disposal—Adams County, North Dakota. 82 pp., illus.

Glossary

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

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

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

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

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clinker. A rough, jagged fragment that resembles the clinker, or slag, of a furnace. A byproduct of burning coal veins. Generally, a few inches to 2 or 3 feet in diameter.

Coarse textured soil. Sand or loamy sand.

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.

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

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

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.

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.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

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

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

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

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.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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).

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.

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

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

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.

Saline-alkali soil. A soil containing soluble salts in an amount that impairs the growth of plants. The soil has 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.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Scab 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.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

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

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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 separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. An A horizon 10 inches or more thick. It includes all subdivisions of this horizon.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-80 at Hettinger, North Dakota]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	23.0	1.3	12.2	54	-31	17	0.31	0.13	0.46	1	4.4
February---	30.1	8.7	19.4	61	-24	19	.31	.12	.46	1	4.7
March------	38.8	16.9	27.9	73	-19	56	.49	.22	.72	2	6.2
April------	54.8	30.1	42.5	84	8	167	1.68	.67	2.52	5	2.9
May--------	67.1	40.9	54.0	90	21	434	2.76	1.25	4.04	6	1.0
June-------	76.1	50.8	63.5	97	34	705	3.64	1.95	5.11	7	.2
July-------	84.6	55.7	70.2	102	41	936	2.04	.83	3.06	5	.0
August-----	83.8	53.7	68.8	101	38	893	1.77	.54	2.76	4	.0
September--	71.7	42.5	57.1	97	23	513	1.43	.29	2.30	3	.2
October----	60.3	32.3	46.3	87	13	243	.85	.12	1.40	2	1.3
November---	41.6	19.0	30.3	72	-8	37	.42	.02	.71	2	3.5
December---	29.8	8.4	19.1	59	-24	21	.27	.06	.44	1	4.4
Yearly:											
Average--	55.1	30.0	42.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	103	-31	---	---	---	---	---	---
Total----	---	---	---	---	---	4,041	15.97	12.24	19.28	39	28.8

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-80 at Hettinger, North Dakota]

Probability	Temperature		
	24^{o} F or lower	28^{o} F or lower	32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 14	May 25	June 4
2 years in 10 later than--	May 8	May 19	May 29
5 years in 10 later than--	Apr. 28	May 7	May 18
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 25	Sept. 11	Sept. 6
2 years in 10 earlier than--	Sept. 30	Sept. 17	Sept. 9
5 years in 10 earlier than--	Oct. 9	Sept. 28	Sept. 16

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-80 at Hettinger, North Dakota]

Probability	Daily minimum temperature during growing season		
	Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	142	118	102
8 years in 10	150	126	108
5 years in 10	164	143	121
2 years in 10	178	160	133
1 year in 10	185	168	140

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

Map symbol	Soil name	Acres	Percent
2	Heil silt loam	2,625	0.4
3	Dimmick silty clay	500	0.1
4	Grail clay loam, 1 to 3 percent slopes	12,950	2.0
5C	Wayden silty clay, 2 to 9 percent slopes	2,700	0.4
6B	Vebar-Parshall fine sandy loams, 1 to 6 percent slopes	34,350	5.5
7C	Vebar-Flasher fine sandy loams, 3 to 9 percent slopes	42,750	6.8
8	Belfield-Savage-Daglum silt loams, 1 to 3 percent slopes	64,300	10.2
8B	Belfield-Savage-Daglum silt loams, 3 to 6 percent slopes	30,610	4.8
9B	Regent silty clay loam, 3 to 6 percent slopes	17,125	2.7
9C	Regent-Cabba complex, 6 to 9 percent slopes	5,950	0.9
10B	Beisigl-Lihen loamy fine sands, 1 to 6 percent slopes	7,100	1.1
10D	Beisigl-Flasher loamy fine sands, 6 to 20 percent slopes	53,100	8.4
11B	Moreau silty clay, 3 to 6 percent slopes	7,025	1.1
12B	Rhoades-Daglum silt loams, 1 to 6 percent slopes	26,550	4.2
13	Lawther silty clay, 1 to 3 percent slopes	3,775	0.6
14B	Parshall fine sandy loam, 1 to 6 percent slopes	37,135	5.9
15	Arnegard loam, 1 to 3 percent slopes	13,345	2.1
16	Shambo loam, 1 to 3 percent slopes	19,725	3.1
16B	Shambo loam, 3 to 6 percent slopes	15,400	2.4
17B	Sen silt loam, 3 to 6 percent slopes	12,150	1.9
17C	Chama-Cabba silt loams, 6 to 9 percent slopes	10,025	1.6
17D	Chama-Cabba silt loams, 9 to 15 percent slopes	2,775	0.4
18B	Amor loam, 3 to 6 percent slopes	27,725	4.4
18C	Amor-Cabba loams, 6 to 9 percent slopes	26,125	4.1
18D	Amor-Cabba loams, 9 to 15 percent slopes	8,125	1.3
19F	Cabba-Chama silt loams, 15 to 70 percent slopes	7,575	1.2
20F	Flasher-Beisigl-Lihen complex, 6 to 70 percent slopes	4,100	0.6
21	Ruso fine sandy loam, 1 to 3 percent slopes	6,200	1.0
22	Bowdle loam, 0 to 3 percent slopes	9,200	1.5
22B	Bowdle loam, 3 to 6 percent slopes	4,000	0.6
23F	Flasher-Beisigl-Rock outcrop complex, 9 to 70 percent slopes	13,175	2.1
24	Straw loam, 0 to 3 percent slopes	2,825	0.4
25B	Lihen loamy fine sand, 1 to 6 percent slopes	6,400	1.0
26	Regan silt loam, 0 to 3 percent slopes	6,150	1.0
27E	Sinnigam-Daglum complex, 1 to 25 percent slopes	7,625	1.2
28	Harriet loam	19,125	3.1
29	Korchea loam	10,555	1.7
30	Straw loam, channeled	11,475	1.8
31B	Watrous loam, 1 to 6 percent slopes	3,175	0.5
32	Dumps-Pits complex	600	0.1
33B	Savage clay loam, 3 to 6 percent slopes	10,975	1.7
34F	Cabba-Brandenburg-Savage complex, 6 to 70 percent slopes	1,225	0.2
35F	Cabba-Amor-Savage complex, 9 to 70 percent slopes	10,400	1.6
36	Velva fine sandy loam	1,300	0.2
37B	Ekalaka fine sandy loam, 1 to 6 percent slopes	3,950	0.6
41	Grail clay loam, saline, 1 to 3 percent slopes	875	0.1
51	Parshall fine sandy loam, saline, 1 to 3 percent slopes	1,815	0.3
61	Arnegard loam, saline, 1 to 3 percent slopes	1,055	0.2
81	Belfield-Savage-Daglum silt loams, saline, 1 to 3 percent slopes	5,060	0.8
	Water	825	0.1
	Total	633,600	100.0

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

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Spring wheat	Barley	Oats	Rye	Crested wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Tons
2 Heil	---	---	---	---	1.1
3* Dimmick	22	36	47	28	1.8
4 Grail	28	46	60	36	2.3
5C. Wayden					
6B Vebar-Parshall	18	29	38	23	1.2
7C Vebar-Flasher	16	26	34	20	0.8
8 Belfield-Savage-Daglum	21	34	45	27	1.3
8B Belfield-Savage-Daglum	19	31	40	24	1.3
9B Regent	22	36	47	28	1.4
9C Regent-Cabba	16	26	34	20	1.0
10B Beisigl-Lihen	11	18	23	14	1.2
10D Beisigl-Flasher	---	---	---	---	0.8
11B Moreau	17	28	36	22	1.6
12B. Rhoades-Daglum					
13 Lawther	26	42	55	33	1.6
14B Parshall	21	34	47	27	1.3
15 Arnegard	31	50	66	40	2.3
16 Shambo	26	42	55	33	1.7
16B Shambo	24	39	51	31	1.7
17B Sen	23	37	49	29	1.4

See footnotes at end of table.

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

Soil name and map symbol	Spring wheat	Barley	Oats	Rye	Crested wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Tons
17C------------------------ Chama-Cabba	14	23	30	18	1.1
17D------------------------ Chama-Cabba	---	---	---	---	0.9
18B------------------------ Amor	22	36	47	28	1.4
18C------------------------ Amor-Cabba	14	23	30	18	1.0
18D------------------------ Amor-Cabba	---	---	---	---	1.0
19F. Cabba-Chama					
20F. Flasher-Beisigl-Lihen					
21------------------------- Ruso	14	23	30	18	1.4
22------------------------- Bowdle	18	29	38	23	1.7
22B------------------------ Bowdle	17	28	36	22	1.7
23F. Flasher-Beisigl-Rock outcrop					
24------------------------- Straw	28	46	60	36	2.3
25B------------------------ Lihen	13	21	28	17	1.3
26*------------------------ Regan	20	34	40	14	2.1
27E. Sinnigam-Daglum					
28. Harriet					
29------------------------- Korchea	27	44	57	34	2.3
30. Straw					
31B------------------------ Watrous	17	28	36	22	1.4
32**. Dumps-Pits					

See footnotes at end of table.

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

Soil name and map symbol	Spring wheat	Barley	Oats	Rye	Crested wheatgrass-alfalfa hay
	Bu	Bu	Bu	Bu	Tons
33B------------------------ Savage	22	36	47	28	1.6
34F. Cabba-Brandenburg-Savage					
35F. Cabba-Amor-Savage					
36------------------------ Velva	22	36	47	28	2.3
37B------------------------ Ekalaka	13	21	28	17	1.0
41------------------------ Grail	14	23	30	18	1.4
51------------------------ Parshall	11	18	23	14	1.4
61------------------------ Arnegard	15	24	32	19	1.4
81------------------------ Belfield-Savage-Daglum	11	18	23	14	1.4

* Yields are for drained areas.
** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
2: Heil	Closed Depression	3,000	2,600	2,200
3: Dimmick	Wetland	5,700	5,200	4,700
4: Grail	Overflow	3,400	2,900	2,400
5C: Wayden	Shallow Clay	1,200	1,000	800
6B*:				
Vebar	Sandy	2,400	2,100	1,800
Parshall	Sandy	2,400	2,100	1,800
7C*:				
Vebar	Sandy	2,400	2,100	1,800
Flasher	Shallow	1,700	1,500	1,200
8*, 8B*:				
Belfield	Clayey	2,300	2,000	1,700
Savage	Clayey	2,300	2,000	1,700
Daglum	Claypan	1,600	1,400	1,200
9B: Regent	Clayey	2,300	2,000	1,700
9C*:				
Regent	Clayey	2,300	2,000	1,700
Cabba	Shallow	1,700	1,500	1,200
10B*:				
Beisigl	Sands	2,500	2,300	2,000
Lihen	Sands	2,500	2,300	2,000
10D*:				
Beisigl	Sands	2,500	2,300	2,000
Flasher	Shallow	1,700	1,500	1,200
11B: Moreau	Clayey	2,300	2,000	1,700
12B*:				
Rhoades	Thin Claypan	900	700	500
Daglum	Claypan	1,600	1,400	1,200
13: Lawther	Clayey	2,300	2,000	1,700

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
14B----------------------- Parshall	Sandy-----------------------------------	2,400	2,100	1,800
15------------------------ Arnegard	Overflow--------------------------------	3,400	2,900	2,400
16, 16B------------------- Shambo	Silty-----------------------------------	2,300	2,000	1,700
17B----------------------- Sen	Silty-----------------------------------	2,300	2,000	1,700
17C*, 17D*:				
Chama--------------------	Silty-----------------------------------	2,300	2,000	1,700
Cabba--------------------	Shallow---------------------------------	1,700	1,500	1,200
18B----------------------- Amor	Silty-----------------------------------	2,300	2,000	1,700
18C*, 18D*:				
Amor---------------------	Silty-----------------------------------	2,300	2,000	1,700
Cabba--------------------	Shallow---------------------------------	1,700	1,500	1,200
19F*:				
Cabba--------------------	Shallow---------------------------------	1,700	1,500	1,200
Chama--------------------	Silty-----------------------------------	2,300	2,000	1,700
20F*:				
Flasher------------------	Shallow---------------------------------	1,700	1,500	1,200
Beisigl------------------	Sands-----------------------------------	2,500	2,300	2,000
Lihen--------------------	Sands-----------------------------------	2,500	2,300	2,000
21------------------------ Ruso	Sandy-----------------------------------	2,400	2,100	1,800
22, 22B------------------- Bowdle	Silty-----------------------------------	2,300	2,000	1,700
23F*:				
Flasher------------------	Shallow---------------------------------	1,700	1,500	1,200
Beisigl------------------	Sands-----------------------------------	2,500	2,300	2,000
Rock outcrop.				
24------------------------ Straw	Silty-----------------------------------	2,300	2,000	1,700
25B----------------------- Lihen	Sands-----------------------------------	2,500	2,300	2,000
26------------------------ Regan	Subirrigated----------------------------	4,400	4,000	3,600
27E*:				
Sinnigam-----------------	Shallow to Gravel-----------------------	1,600	1,300	1,000

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
27E*:				
Daglum	Claypan	1,600	1,400	1,200
28 Harriet	Saline Lowland	3,000	2,600	2,200
29 Korchea	Silty	2,300	2,000	1,700
30 Straw	Overflow	3,400	2,900	2,400
31B Watrous	Silty	2,300	2,000	1,700
33B Savage	Clayey	2,300	2,000	1,700
34F*:				
Cabba	Shallow	1,700	1,500	1,200
Brandenburg	Very Shallow	900	700	500
Savage	Clayey	2,300	2,000	1,700
35F*:				
Cabba	Shallow	1,700	1,500	1,200
Amor	Silty	2,300	2,000	1,700
Savage	Clayey	2,300	2,000	1,700
36 Velva	Sandy	2,400	2,100	1,800
37B Ekalaka	Sandy Claypan	2,700	2,000	1,300
41 Grail	Saline Lowland	3,000	2,600	2,200
51 Parshall	Saline Lowland	3,000	2,600	2,200
61 Arnegard	Saline Lowland	3,000	2,600	2,200
81*:				
Belfield	Saline Lowland	3,000	2,600	2,200
Savage	Saline Lowland	3,000	2,600	2,200
Daglum	Saline Lowland	3,000	2,600	2,200

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

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
2. Heil					
3 Dimmick	American plum, redosier dogwood, Siberian peashrub, Tatarian honeysuckle.	Black Hills spruce, eastern redcedar, Siberian crabapple, common chokecherry, lilac.	Green ash	Golden willow	Plains cottonwood.
4 Grail	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
5C. Wayden					
6B*:					
Vebar	Tatarian honeysuckle, lilac, silver buffaloberry.	Bur oak, Siberian peashrub, eastern redcedar, common chokecherry, American plum, Siberian crabapple.	Russian-olive, green ash, ponderosa pine.	---	---
Parshall	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
7C*:					
Vebar	Tatarian honeysuckle, lilac, silver buffaloberry.	Bur oak, Siberian peashrub, eastern redcedar, common chokecherry, American plum, Siberian crabapple.	Russian-olive, green ash, ponderosa pine.	---	---
Flasher.					

See footnote at end of table.

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

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
8*, 8B*:					
Belfield	Siberian peashrub, golden currant, American plum, lilac.	Green ash, eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
Savage	---	Lilac, American elm, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, Black Hills spruce.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
Daglum	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
9B Regent	Siberian peashrub, lilac, American plum, golden currant.	Ponderosa pine, green ash, Russian-olive, common chokecherry, Rocky Mountain juniper, eastern redcedar.	Siberian elm	---	---
9C*:					
Regent	Siberian peashrub, lilac, American plum, golden currant.	Ponderosa pine, green ash, Russian-olive, common chokecherry, Rocky Mountain juniper, eastern redcedar.	Siberian elm	---	---
Cabba.					
10B*:					
Beisigl	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---

See footnote at end of table.

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

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
10B*:					
Lihen	American plum, silver buffaloberry.	Bur oak, Siberian crabapple, Siberian peashrub, common chokecherry, Tatarian honeysuckle, eastern redcedar, lilac.	Ponderosa pine, green ash, Russian-olive.	---	---
10D*:					
Beisigl.					
Flasher.					
11B Moreau	Golden currant, Siberian peashrub, lilac, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
12B*:					
Rhoades.					
Daglum	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
13 Lawther	Golden currant, Siberian peashrub, lilac, American plum.	Green ash, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry, eastern redcedar.	Siberian elm	---	---
14B Parshall	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
15 Arnegard	Peking cotoneaster, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, Black Hills spruce, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---

See footnote at end of table.

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

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
16, 16B: Shambo	---	Black Hills spruce, eastern redcedar, Russian-olive, Siberian peashrub, common chokecherry, lilac, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
17B: Sen	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Siberian crabapple, bur oak, green ash, ponderosa pine.	---	---
17C*, 17D*:					
Chama	---	Black Hills spruce, eastern redcedar, Russian-olive, Tatarian honeysuckle, Siberian peashrub, American plum, common chokecherry, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
Cabba.					
18B: Amor	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
18C*, 18D*:					
Amor	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---

See footnote at end of table.

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

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
18C*, 18D*: Cabba.					
19F*: Cabba.					
Chama.					
20F*: Flasher.					
Beisigl.					
Lihen	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
21 Ruso	---	Ponderosa pine, Siberian peashrub, Russian-olive, eastern redcedar, Rocky Mountain juniper.	Siberian elm, green ash.	---	---
22, 22B Bowdle	---	Ponderosa pine, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Siberian elm, green ash.	---	---
23F*: Flasher.					
Beisigl.					
Rock outcrop.					
24 Straw	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
25B Lihen	American plum, silver buffaloberry.	Bur oak, Siberian crabapple, Siberian peashrub, common chokecherry, Tatarian honeysuckle, eastern redcedar, lilac.	Ponderosa pine, green ash, Russian-olive.	---	---

See footnote at end of table.

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

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
26 Regan	Redosier dogwood, Siberian peashrub, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, eastern redcedar, lilac, common chokecherry.	Green ash	Golden willow	Plains cottonwood.
27E*: Sinnigam.					
Daglum.					
28. Harriet					
29 Korchea	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
30 Straw	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
31B Watrous	---	American plum, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, lilac, Tatarian honeysuckle.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
32*. Dumps-Pits					
33B Savage	---	Lilac, American elm, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, Black Hills spruce.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
34F*: Cabba.					
Brandenburg.					

See footnote at end of table.

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

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
34F*:					
Savage	---	Lilac, American elm, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, Black Hills spruce.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
35F*:					
Cabba.					
Amor.					
Savage	---	Lilac, American elm, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, Black Hills spruce.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
36 Velva	Tatarian honeysuckle, American plum, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, Siberian peashrub, common chokecherry, eastern redcedar.	Golden willow, ponderosa pine.	Plains cottonwood	---
37B Ekalaka	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
41 Grail	Silver buffaloberry, Siberian peashrub.	Russian-olive, green ash, Siberian elm.	---	---	---
51 Parshall	Silver buffaloberry, Siberian peashrub.	Russian-olive, green ash, Siberian elm.	---	---	---
61 Arnegard	Silver buffaloberry, Siberian peashrub.	Russian-olive, green ash, Siberian elm.	---	---	---

See footnote at end of table.

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

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
81*:					
Belfield	Silver buffaloberry, Siberian peashrub.	Russian-olive, green ash, Siberian elm.	---	---	---
Savage	Siberian peashrub	Russian-olive, green ash, Siberian elm.	---	---	---
Daglum	Silver buffaloberry, Siberian peashrub, Russian-olive, green ash.	Siberian elm	---	---	---

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

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
2 Heil	Severe: ponding, percs slowly.	Severe: ponding, excess sodium.	Severe: ponding, percs slowly.	Severe: ponding.
3 Dimmick	Severe: ponding, percs slowly, too clayey.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.
4 Grail	Slight	Slight	Moderate: slope.	Slight.
5C Wayden	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.
6B*:				
Vebar	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Parshall	Slight	Slight	Moderate: slope.	Slight.
7C*:				
Vebar	Slight	Slight	Severe: slope.	Slight.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
8*, 8B*:				
Belfield	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Savage	Slight	Slight	Moderate: slope.	Slight.
Daglum	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
9B Regent	Slight	Slight	Moderate: slope.	Slight.
9C*:				
Regent	Slight	Slight	Severe: slope.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
10B*:				
Beisigl	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
10B*:				
Lihen	Slight	Slight	Moderate: slope.	Slight.
10D*:				
Beisigl	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Flasher	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
11B Moreau	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
12B*:				
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Daglum	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
13 Lawther	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
14B Parshall	Slight	Slight	Moderate: slope.	Slight.
15 Arnegard	Slight	Slight	Moderate: slope.	Slight.
16, 16B Shambo	Slight	Slight	Moderate: slope.	Slight.
17B Sen	Slight	Slight	Moderate: slope, depth to rock.	Slight.
17C*:				
Chama	Slight	Slight	Severe: slope.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
17D*:				
Chama	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
18B Amor	Slight	Slight	Moderate: slope, depth to rock.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
18C*:				
Amor	Slight	Slight	Severe: slope.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
18D*:				
Amor	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
19F*:				
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Chama	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
20F*:				
Flasher	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, depth to rock.	Severe: slope.
Beisigl	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: slope.
Lihen	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
21 Ruso	Slight	Slight	Moderate: slope.	Slight.
22 Bowdle	Slight	Slight	Slight	Slight.
22B Bowdle	Slight	Slight	Moderate: slope.	Slight.
23F*:				
Flasher	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Beisigl	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.				
24 Straw	Severe: flooding.	Slight	Slight	Slight.
25B Lihen	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
26. Regan				
27E*: Sinnigam	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, small stones.	Moderate: large stones.
Daglum	Severe: slope, excess sodium.	Severe: slope, excess sodium.	Severe: slope, excess sodium.	Moderate: slope.
28 Harriet	Severe: flooding, wetness, percs slowly.	Severe: wetness, excess sodium, percs slowly.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness.
29 Korchea	Severe: flooding.	Slight	Moderate: flooding.	Slight.
30 Straw	Severe: flooding.	Moderate: flooding.	Slight	Moderate: flooding.
31B Watrous	Slight	Slight	Moderate: slope, depth to rock.	Slight.
32*. Dumps-Pits				
33B Savage	Slight	Slight	Moderate: slope.	Slight.
34F*: Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Brandenburg	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.
Savage	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
35F*: Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope.	Severe: slope.
Amor	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Moderate: slope.
Savage	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
36 Velva	Severe: flooding.	Slight	Moderate: flooding.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
37B: Ekalaka	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
41: Grail	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
51: Parshall	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
61: Arnegard	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
81*:				
Belfield	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight.
Savage	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
Daglum	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight.

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

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
2 Heil	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.
3 Dimmick	Fair	Fair	Poor	Poor	Good	Good	Fair	Good	Poor.
4 Grail	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
5C Wayden	Poor	Fair	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
6B*:									
Vebar	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.
Parshall	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
7C*:									
Vebar	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.
Flasher	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
8*, 8B*:									
Belfield	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Savage	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Daglum	Fair	Good	Fair	Very poor	Poor	Poor	Fair	Poor	Poor.
9B Regent	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
9C*:									
Regent	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Cabba	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
10B*:									
Beisigl	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Lihen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
10D*:									
Beisigl	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Flasher	Poor	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
11B Moreau	Fair	Good	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
12B*:									
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
Daglum	Fair	Good	Fair	Very poor	Poor	Poor	Fair	Poor	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
13 Lawther	Good	Good	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
14B Parshall	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
15 Arnegard	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
16, 16B Shambo	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
17B Sen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
17C*, 17D*:									
Chama	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Cabba	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
18B Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
18C*, 18D*:									
Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cabba	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
19F*:									
Cabba	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Chama	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
20F*:									
Flasher	Very poor	Very poor	Very poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
Beisigl	Very poor	Very poor	Very poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
Lihen	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
21 Ruso	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
22, 22B Bowdle	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Good.
23F*:									
Flasher	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Beisigl	Very poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Rock outcrop.									
24 Straw	Good	Good	Good	Good	Good	Good	Good	Good	Good.
25B Lihen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
26. Regan	Good	Good	Good	Fair	Good	Good	Good	Good	Fair.
27E*:									
Sinnigam	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Daglum	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor	Very poor	Poor.
28. Harriet	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.
29. Korchea	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
30. Straw	Very poor	Very poor	Good	Good	Good	Good	Poor	Good	Good.
31B. Watrous	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
32*. Dumps-Pits									
33B. Savage	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
34F*:									
Cabba	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Brandenburg	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Savage	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
35F*:									
Cabba	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Fair.
Amor	Poor	Very poor	Good	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Savage	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
36. Velva	Fair	Good	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
37B. Ekalaka	Fair	Good	Poor	Fair	Poor	Very poor	Fair	Very poor	Poor.
41. Grail	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair	Very poor	Very poor.
51. Parshall	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair	Very poor	Very poor.
61. Arnegard	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair	Very poor	Very poor.
81*:									
Belfield	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair	Very poor	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
81*:									
Savage	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair	Very poor	Very poor.
Daglum	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.

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

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
2: Heil	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
3: Dimmick	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
4: Grail	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
5C: Wayden	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
6B*:					
Vebar	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Slight	Slight.
Parshall	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
7C*:					
Vebar	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight.
Flasher	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.
8*, 8B*:					
Belfield	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Savage	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Daglum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
9B: Regent	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
9C*:					
Regent	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
9C*:					
Cabba	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, shrink-swell.
10B*:					
Beisigl	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Slight	Slight.
Lihen	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
10D*:					
Beisigl	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
Flasher	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
11B Moreau	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
12B*:					
Rhoades	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Daglum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
13 Lawther	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
14B Parshall	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
15 Arnegard	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
16 Shambo	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.
16B Shambo	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
17B Sen	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
17C*:					
Chama	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
17C*:					
Cabba------------	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, shrink-swell.
17D*:					
Chama------------	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Cabba------------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, shrink-swell, slope.
18B--------------- Amor	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
18C*:					
Amor-------------	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cabba------------	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, shrink-swell.
18D*:					
Amor-------------	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Cabba------------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, shrink-swell, slope.
19F*:					
Cabba------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Chama------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
20F*:					
Flasher----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Beisigl----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
20F*:					
Lihen	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
21 Ruso	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
22 Bowdle	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
22B Bowdle	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
23F*:					
Flasher	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Beisigl	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
24 Straw	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
25B Lihen	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
26 Regan	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.
27E*:					
Sinnigam	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Daglum	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
28 Harriet	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, low strength.
29 Korchea	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
30 Straw	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
31B Watrous	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.
32*. Dumps-Pits					

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
33B------------- Savage	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
34F*:					
Cabba-----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Brandenburg------	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
Savage----------	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
35F*:					
Cabba-----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Amor------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Savage----------	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
36-------------- Velva	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
37B------------- Ekalaka	Severe: cutbanks cave.	Slight----------	Slight----------	Slight----------	Moderate: frost action.
41-------------- Grail	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
51-------------- Parshall	Severe: cutbanks cave.	Slight----------	Moderate: wetness.	Slight----------	Moderate: frost action.
61-------------- Arnegard	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength.
81*:					
Belfield---------	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Savage----------	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Daglum----------	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

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

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2------------------- Heil	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
3------------------- Dimmick	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
4------------------- Grail	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
5C------------------ Wayden	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
6B*:					
Vebar---------------	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
Parshall------------	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
7C*:					
Vebar---------------	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
Flasher-------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock.
8*, 8B*:					
Belfield------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight-----------	Poor: too clayey, hard to pack, excess sodium.
Savage--------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Daglum--------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight-----------	Poor: too clayey, excess sodium.
9B------------------ Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
9C*:					
Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Cabba	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
10B*:					
Beisigl	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock, too sandy.
Lihen	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
10D*:					
Beisigl	Severe: depth to rock, poor filter.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock, too sandy.
Flasher	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock.
11B Moreau	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
12B*:					
Rhoades	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack.
Daglum	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, excess sodium.
13 Lawther	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
14B Parshall	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
15 Arnegard	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey, too sandy.	Slight	Fair: too clayey, too sandy.
16, 16B Shambo	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
17B Sen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
17C*, 17D*:					
Chama	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Cabba	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
18B Amor	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
18C*, 18D*:					
Amor	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Cabba	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
19F*:					
Cabba	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Chama	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
20F*:					
Flasher	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Beisigl	Severe: depth to rock, poor filter, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: depth to rock, too sandy, slope.
Lihen	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
21 Ruso	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
22, 22B Bowdle	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
23F*:					
Flasher	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
23F*:					
Beisigl	Severe: depth to rock, poor filter, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: depth to rock, too sandy, slope.
Rock outcrop.					
24 Straw	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: too clayey.
25B Lihen	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
26 Regan	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
27E*:					
Sinnigam	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, small stones.
Daglum	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, slope, excess sodium.
28 Harriet	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: hard to pack, wetness, excess sodium.
29 Korchea	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
30 Straw	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: too clayey.
31B Watrous	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
32*. Dumps-Pits					
33B Savage	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
34F*:					
Cabba	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Brandenburg	Severe: poor filter, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: seepage, small stones, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
34F*:					
Savage	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
35F*:					
Cabba	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Amor	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Savage	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
36 Velva	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
37B Ekalaka	Severe: percs slowly.	Severe: seepage.	Severe: depth to rock, seepage, too sandy.	Severe: seepage.	Poor: too sandy, excess sodium.
41 Grail	Severe: percs slowly.	Moderate: slope, wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
51 Parshall	Moderate: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Fair: too sandy.
61 Arnegard	Moderate: wetness, percs slowly.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
81*:					
Belfield	Severe: percs slowly.	Moderate: slope, wetness.	Severe: wetness, too clayey, excess sodium.	Moderate: wetness.	Poor: too clayey, hard to pack, excess sodium.
Savage	Severe: percs slowly.	Moderate: slope, wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Daglum	Severe: percs slowly.	Moderate: slope, wetness.	Severe: wetness, too clayey, excess sodium.	Moderate: wetness.	Poor: too clayey, excess sodium.

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

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
2 Heil	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
3 Dimmick	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
4 Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
5C Wayden	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey.
6B*:				
Vebar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
Parshall	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
7C*:				
Vebar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
Flasher	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
8*, 8B*:				
Belfield	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Savage	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Daglum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
9B Regent	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
9C*:				
Regent	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
10B*:				
Beisigl	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Lihen	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
10D*:				
Beisigl	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Flasher	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
11B Moreau	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
12B*:				
Rhoades	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Daglum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
13 Lawther	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
14B Parshall	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
15 Arnegard	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
16, 16B Shambo	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
17B Sen	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
17C*:				
Chama	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
17D*:				
Chama	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, slope.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
18B Amor	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
18C*:				
Amor	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
18D*:				
Amor	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, thin layer, slope.
Cabba	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
19F*:				
Cabba	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Chama	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
20F*:				
Flasher	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones, slope.
Beisigl	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope.
Lihen	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
21 Ruso	Good	Probable	Probable	Poor: small stones, area reclaim.
22, 22B Bowdle	Good	Probable	Probable	Fair: area reclaim.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
23F*:				
Flasher	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Beisigl	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
Rock outcrop.				
24 Straw	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
25B Lihen	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
26 Regan	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
27E*:				
Sinnigam	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Daglum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
28 Harriet	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
29 Korchea	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
30 Straw	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
31B Watrous	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones, thin layer.
32*. Dumps-Pits				
33B Savage	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
34F*:				
Cabba	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Brandenburg	Poor: large stones, slope.	Improbable: small stones, large stones.	Improbable: large stones.	Poor: small stones, area reclaim, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
34F*:				
Savage	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
35F*:				
Cabba	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Amor	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, slope.
Savage	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
36 Velva	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
37B Ekalaka	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
41 Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
51 Parshall	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
61 Arnegard	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
81*:				
Belfield	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
Savage	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
Daglum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.

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

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
2----------------- Heil	Slight---------	Severe: hard to pack, ponding, excess sodium.	Ponding, percs slowly, excess salt.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, excess sodium, percs slowly.
3----------------- Dimmick	Slight---------	Severe: hard to pack, ponding.	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
4----------------- Grail	Slight---------	Moderate: piping, hard to pack.	Deep to water	Percs slowly---	Percs slowly---	Percs slowly.
5C---------------- Wayden	Severe: depth to rock.	Severe: thin layer.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
6B*:						
Vebar------------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
Parshall---------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
7C*:						
Vebar------------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
Flasher----------	Severe: depth to rock.	Severe: thin layer.	Deep to water	Soil blowing---	Depth to rock, soil blowing.	Depth to rock.
8*:						
Belfield---------	Slight---------	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Percs slowly---	Excess sodium, percs slowly.
Savage-----------	Slight---------	Severe: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Daglum-----------	Slight---------	Severe: excess sodium.	Deep to water	Percs slowly---	Percs slowly---	Excess sodium, percs slowly.
8B*:						
Belfield---------	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope, excess sodium.	Percs slowly---	Excess sodium, percs slowly.
Savage-----------	Moderate: slope.	Severe: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Daglum-----------	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly---	Excess sodium, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
9B Regent	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
9C*:						
Regent	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Cabba	Severe: depth to rock.	Severe: piping.	Deep to water	Slope, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
10B*:						
Beisigl	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Depth to rock, too sandy.	Droughty, depth to rock.
Lihen	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
10D*:						
Beisigl	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
Flasher	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
11B Moreau	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
12B*:						
Rhoades	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
Daglum	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
13 Lawther	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Excess salt, percs slowly.
14B Parshall	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
15 Arnegard	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
16 Shambo	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
16B Shambo	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
17B Sen	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
17C*:						
Chama	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Cabba	Severe: depth to rock.	Severe: piping.	Deep to water	Slope, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
17D*:						
Chama	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
18B Amor	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
18C*:						
Amor	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
Cabba	Severe: depth to rock.	Severe: piping.	Deep to water	Slope, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
18D*:						
Amor	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
19F*:						
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Chama	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
20F*:						
Flasher	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope.
Beisigl	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Lihen	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
21----------------- Ruso	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
22----------------- Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Favorable------	Too sandy------	Favorable.
22B---------------- Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Slope----------	Too sandy------	Favorable.
23F*:						
Flasher----------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, soil blowing.	Slope, droughty, depth to rock.
Beisigl----------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, depth to rock, too sandy.	Slope, droughty, depth to rock.
Rock outcrop.						
24----------------- Straw	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Favorable------	Favorable.
25B---------------- Lihen	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
26----------------- Regan	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding, excess salt.	Wetness--------	Wetness.
27E*:						
Sinnigam---------	Severe: depth to rock.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty.
Daglum-----------	Severe: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Slope, percs slowly.	Slope, excess sodium, percs slowly.
28----------------- Harriet	Slight---------	Severe: piping, wetness, excess sodium.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, excess sodium, erodes easily.
29----------------- Korchea	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
30----------------- Straw	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Favorable------	Favorable.
31B---------------- Watrous	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
32*. Dumps-Pits						
33B---------------- Savage	Moderate: slope.	Severe: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
34F*:						
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Brandenburg	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
Savage	Severe: slope.	Severe: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
35F*:						
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, excess salt.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Amor	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Savage	Severe: slope.	Severe: hard to pack.	Deep to water	Percs slowly, slope, erodes easily.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
36 Velva	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
37B Ekalaka	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Excess sodium, droughty.
41 Grail	Slight	Moderate: piping, hard to pack, excess salt.	Deep to water	Droughty, percs slowly, excess salt.	Percs slowly	Excess salt, droughty, percs slowly.
51 Parshall	Severe: seepage.	Severe: piping.	Deep to water	Droughty, soil blowing, excess salt.	Too sandy, soil blowing.	Excess salt, droughty.
61 Arnegard	Moderate: seepage.	Severe: piping.	Deep to water	Droughty, excess salt.	Favorable	Excess salt, droughty.
81*:						
Belfield	Slight	Severe: excess sodium.	Deep to water	Droughty, percs slowly, excess sodium.	Percs slowly	Excess salt, excess sodium, droughty.
Savage	Slight	Severe: hard to pack.	Deep to water	Droughty, percs slowly, erodes easily.	Erodes easily, percs slowly.	Excess salt, erodes easily, droughty.
Daglum	Slight	Severe: excess sodium.	Deep to water	Droughty, percs slowly.	Percs slowly	Excess salt, excess sodium, droughty.

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

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
2---------------- Heil	0-4	Silt loam---------	CL	A-6, A-7	0	100	100	90-100	70-95	25-50	10-25
	4-20	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
	20-60	Silty clay, silty clay loam, loam.	CH, CL	A-7, A-6	0	100	100	85-100	60-95	25-60	11-45
3---------------- Dimmick	0-22	Silty clay--------	CH, CL	A-7	0	100	100	90-100	75-95	40-60	15-35
	22-60	Clay, silty clay	CH, CL	A-7	0	100	100	90-100	75-95	45-70	20-45
4---------------- Grail	0-9	Clay loam---------	CL	A-6, A-7	0	100	95-100	90-100	70-80	30-50	10-30
	9-22	Silty clay, clay loam, clay.	CL, CH, ML	A-7, A-6	0	100	95-100	95-100	70-95	35-60	10-35
	22-60	Clay loam, silty clay loam, sandy clay loam.	CL, CH	A-6, A-7	0	100	95-100	85-100	60-95	30-55	10-30
5C--------------- Wayden	0-4	Silty clay--------	CH, CL	A-7	0	100	100	90-100	75-95	40-60	15-30
	4-18	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-60	15-30
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
6B*:											
Vebar------------	0-29	Fine sandy loam	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	29-34	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Parshall---------	0-10	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	10-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	---	NP
7C*:											
Vebar------------	0-29	Fine sandy loam	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	29-34	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-4, A-2	0	95-100	90-100	60-100	30-55	---	NP
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Flasher----------	0-6	Fine sandy loam	SM	A-2, A-4	0-5	85-100	85-100	60-100	30-50	---	NP
	6-17	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
8*, 8B*:											
Belfield---------	0-9	Silt loam---------	CL	A-6	0	100	100	85-100	60-90	20-40	10-25
	9-20	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	70-95	40-65	15-40
	20-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	90-100	70-95	30-55	10-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
8*, 8B*:											
Savage----------	0-6	Silt loam--------	CL	A-6	0	100	100	90-100	70-80	20-40	10-20
	6-15	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	15-36	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	36-60	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
Daglum----------	0-8	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	15-25
	8-18	Clay, silty clay, clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	18-60	Clay, silty clay, clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30
9B--------------- Regent	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	7-36	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-70	15-45
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
9C*:											
Regent----------	0-5	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	5-25	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-70	15-45
	25-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba-----------	0-4	Silt loam--------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	4-17	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
10B*:											
Beisigl---------	0-5	Loamy fine sand	SM, SM-SC	A-2, A-4	0	95-100	85-100	75-95	20-40	<20	NP-5
	5-27	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	95-100	85-100	50-100	15-35	---	NP
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Lihen-----------	0-18	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	18-60	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	100	100	50-80	15-35	---	NP
10D*:											
Beisigl---------	0-5	Loamy fine sand	SM, SM-SC	A-2, A-4	0	95-100	85-100	75-95	20-40	<20	NP-5
	5-27	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	95-100	85-100	50-100	15-35	---	NP
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Flasher---------	0-3	Loamy fine sand	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	3-17	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
11B-------------- Moreau	0-4	Silty clay-------	CH	A-7	0	100	100	90-100	75-100	50-75	25-50
	4-28	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-100	45-75	20-50
	28-34	Clay, silty clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-100	45-75	20-50
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
12B*: Rhoades---------	0-3	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	3-24	Clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	24-60	Silty clay, silt loam, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
Daglum----------	0-7	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	15-25
	7-18	Clay, silty clay, clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	18-60	Clay, silty clay, clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30
13--------------- Lawther	0-10	Silty clay-------	CL, CH	A-7	0	100	100	90-100	75-100	45-70	25-40
	10-33	Silty clay, clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	75-100	35-70	15-40
	33-60	Silty clay, clay, clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	75-100	35-70	15-40
14B-------------- Parshall	0-10	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	10-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	---	NP
15--------------- Arnegard	0-9	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-90	20-35	5-20
	9-31	Loam, silt loam, clay loam.	CL	A-6	0	100	100	85-100	50-90	25-40	12-25
	31-60	Loam, fine sandy loam, loamy fine sand.	SM, ML, CL, SC	A-4, A-6	0	100	100	70-100	40-80	15-40	NP-15
16, 16B---------- Shambo	0-9	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	3-13
	9-25	Loam, silt loam, sandy clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
	25-60	Stratified fine sandy loam to silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
17B-------------- Sen	0-6	Silt loam--------	CL	A-6	0	100	100	85-100	60-90	25-35	10-20
	6-33	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	85-100	60-95	25-45	10-30
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
17C*, 17D*: Chama-----------	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-20
	8-33	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-50	5-25
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba-----------	0-6	Silt loam--------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	6-16	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	16-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
18B-------------- Amor	0-8	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	65-85	25-40	3-18
	8-36	Clay loam, loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	75-100	50-95	20-45	2-25
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
18C*, 18D*:											
Amor------------	0-8	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	65-85	25-40	3-18
	8-36	Clay loam, loam, fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	95-100	75-100	50-95	20-45	2-25
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba-----------	0-6	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	6-17	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
19F*:											
Cabba-----------	0-4	Silt loam--------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	4-17	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Chama-----------	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-20
	6-33	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-50	5-25
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
20F*:											
Flasher---------	0-3	Extremely stony loamy fine sand.	SM	A-2	3-25	85-100	85-100	50-100	15-35	---	NP
	3-17	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-20	85-100	85-100	50-100	15-35	---	NP
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Beisigl---------	0-5	Extremely stony loamy fine sand.	SM, SM-SC	A-2, A-4	3-25	95-100	85-100	75-95	20-40	<20	NP-5
	5-27	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0-20	95-100	85-100	50-100	15-35	---	NP
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Lihen-----------	0-18	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	18-60	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	100	100	50-80	15-35	---	NP
21--------------- Ruso	0-10	Fine sandy loam	SM	A-2, A-4	0-1	95-100	95-100	60-70	30-40	---	NP
	10-29	Coarse sandy loam, fine sandy loam.	SM	A-2, A-4	0-1	85-100	85-100	60-70	30-40	---	NP
	29-60	Sand and gravel	SP, SM, GM, GP	A-1, A-2	0-5	25-75	15-65	10-40	3-35	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
22, 22B---------- Bowdle	0-5	Loam-------------	ML, CL	A-6, A-4	0	100	95-100	85-95	55-80	30-40	7-15
	5-26	Loam, clay loam	CL, ML	A-4, A-6	0	95-100	90-100	70-95	50-75	30-40	8-15
	26-31	Gravelly loam, sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	90-100	80-100	60-95	30-60	25-35	5-10
	31-60	Very gravelly sand, gravelly loamy sand, very gravelly loamy sand.	SM, SW-SM, SP-SM	A-1, A-2	0-5	60-95	50-85	25-50	5-30	<30	NP-5
23F*:											
Flasher---------	0-3	Loamy fine sand	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	3-17	Loamy sand, loamy fine sand, fine sand.	SM	A-2	0-5	85-100	85-100	50-100	15-35	---	NP
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Beisigl---------	0-5	Loamy fine sand	SM, SM-SC	A-2, A-4	0	95-100	85-100	75-95	20-40	<20	NP-5
	5-27	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	95-100	85-100	50-100	15-35	---	NP
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop.											
24-------------- Straw	0-18	Loam-------------	CL-ML	A-4	0	95-100	90-100	85-100	60-90	20-30	5-10
	18-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6	0	95-100	90-100	85-100	60-85	25-40	5-20
25B------------- Lihen	0-18	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	18-60	Loamy fine sand, loamy sand, fine sand.	SM	A-2	0	100	100	50-80	15-35	---	NP
26-------------- Regan	0-20	Silt loam, loam	CL, CL-ML	A-7, A-6, A-4	0	100	100	90-100	80-95	20-50	5-30
	20-60	Stratified sandy loam to silty clay loam.	ML, CL, SC, SM	A-7, A-6, A-4	0	100	100	65-100	35-95	15-50	NP-30
27E*:											
Sinnigam--------	0-2	Very stony loam	CL-ML, GM-GC, SM-SC	A-4	15-40	60-100	50-90	45-80	35-70	25-30	5-10
	2-13	Extremely stony clay loam, very stony clay, very channery clay loam.	GC	A-6, A-7, A-2	25-50	35-70	30-65	25-60	20-50	35-50	15-25
	13-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Daglum----------	0-8	Silt loam, loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	15-25
	8-18	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	18-34	Clay, silty clay, silty clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
28----------------Harriet	0-3	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	25-40	5-20
	3-16	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-100	35-70	20-40
	16-60	Stratified very fine sandy loam to silty clay.	CL, CL-ML, CH	A-4, A-6, A-7	0	100	100	90-100	60-100	20-65	5-40
29----------------Korchea	0-9	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	75-95	50-70	15-30	5-15
	9-60	Stratified fine sandy loam to silty clay loam.	SM-SC, CL-ML, CL, SC	A-4, A-6, A-7	0	100	100	70-100	40-95	20-50	5-20
30----------------Straw	0-18	Loam-------------	CL-ML	A-4	0	95-100	90-100	85-100	60-90	20-30	5-10
	18-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6	0	95-100	90-100	85-100	60-85	25-40	5-20
31B---------------Watrous	0-6	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-95	60-80	20-40	5-20
	6-27	Loam, clay loam	CL	A-6, A-7	0-5	90-100	85-100	80-100	60-80	25-45	10-30
	27-33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
32*. Dumps-Pits											
33B---------------Savage	0-6	Clay loam--------	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	15-30
	6-15	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	15-36	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	36-60	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
34F*:											
Cabba-----------	0-4	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	4-17	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0-5	95-100	90-100	85-100	80-95	25-35	5-15
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Brandenburg-----	0-18	Channery sandy loam, very channery sandy loam.	CL-ML, GM-GC, CL, SM-SC	A-2, A-4, A-6	0-5	60-100	40-80	35-75	30-65	20-35	5-15
	18-60	Fragmental material.	GP	A-1	80-85	15-25	5-10	0-5	0	---	NP
Savage----------	0-6	Clay loam--------	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	15-30
	6-15	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	15-36	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	36-60	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
35F*:											
Cabba	0-4	Extremely stony loam.	ML, CL-ML, SM, SM-SC	A-4	40-45	95-100	90-100	65-85	45-65	15-30	NP-10
	4-17	Gravelly loam, loam, silty clay loam.	CL, CL-ML, SM-SC, GM-GC	A-4, A-6	0-10	60-100	55-100	50-100	45-95	25-35	5-15
	17-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Amor	0-8	Extremely stony loam.	CL, CL-ML	A-4, A-6	3-25	100	95-100	90-100	65-85	20-40	5-20
	8-36	Clay loam, loam, fine sandy loam.	CL, CL-ML	A-4, A-6, A-7	0-20	100	95-100	75-100	50-95	20-45	5-30
	36-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Savage	0-6	Clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	15-30
	6-15	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	15-36	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	36-60	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
36 Velva	0-4	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	100	100	60-95	35-65	15-25	NP-5
	4-60	Fine sandy loam, very fine sandy loam, loam.	ML, SM	A-4	0	100	100	70-95	40-75	20-30	NP-5
37B Ekalaka	0-17	Fine sandy loam	SM, ML	A-2, A-4	0	100	100	70-85	30-60	20-35	NP-10
	17-24	Fine sandy loam, sandy loam, loamy fine sand.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	100	70-100	30-70	20-35	NP-10
	24-45	Fine sandy loam, loamy fine sand, fine sand.	SM, SC, SM-SC	A-2, A-4, A-6	0	100	100	50-100	30-40	20-40	NP-15
	45-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
41 Grail	0-9	Clay loam	CL	A-6, A-7	0	100	100	90-100	70-80	30-50	10-30
	9-27	Silty clay, clay loam, clay.	CL, CH, ML	A-7, A-6	0	100	100	95-100	70-95	35-60	10-35
	27-60	Loam, silty clay loam, clay.	CL, CH, ML	A-6, A-7	0	100	100	85-100	60-95	30-55	10-30
51 Parshall	0-10	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	10-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	---	NP
61 Arnegard	0-9	Loam	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-90	20-35	5-20
	9-31	Loam, silt loam, clay loam.	CL	A-6	0	100	100	85-100	50-90	25-40	12-25
	31-60	Loam, clay loam, fine sandy loam.	ML, CL, SC, SM	A-4, A-6	0	100	100	70-100	40-80	15-40	NP-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
81*:											
Belfield--------	0-9	Silt loam--------	CL	A-6	0	100	100	85-100	60-90	20-40	10-25
	9-20	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	70-95	40-65	15-40
	20-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	90-100	70-95	30-55	10-30
Savage----------	0-6	Silt loam--------	CL	A-6	0	100	100	90-100	70-80	20-40	10-20
	6-15	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	15-36	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
	36-60	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-45
Daglum----------	0-8	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	15-25
	8-18	Clay, silty clay, clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	18-60	Clay, silty clay, clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30

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

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
2----------------- Heil	0-4	<0.06	0.15-0.24	5.6-7.3	<2	Moderate	0.28	3	7
	4-20	<0.06	0.13-0.18	6.6-9.0	4-16	High------	0.28		
	20-60	<0.06	0.13-0.18	7.4-9.0	4-16	High------	0.28		
3----------------- Dimmick	0-22	<0.2	0.14-0.23	6.1-7.8	<2	High------	0.28	5	4
	22-60	<0.06	0.13-0.20	6.6-8.4	<2	High------	0.28		
4----------------- Grail	0-9	0.2-0.6	0.18-0.20	6.1-8.4	<2	Moderate	0.32	5	7
	9-22	0.06-0.6	0.14-0.17	6.6-8.4	<2	High------	0.32		
	22-60	0.06-0.6	0.13-0.22	7.4-8.4	<4	Moderate	0.32		
5C---------------- Wayden	0-4	0.06-0.2	0.15-0.18	7.4-9.0	<2	High------	0.32	2	4
	4-18	0.06-0.2	0.14-0.19	7.4-9.0	<8	High------	0.32		
	18-60	---	---	---	---	----------	----		
6B*:									
Vebar-----------	0-29	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low-------	0.20	4	3
	29-34	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-------	0.20		
	34-60	---	---	---	---	----------	----		
Parshall--------	0-10	2.0-6.0	0.16-0.18	5.6-8.4	<2	Low-------	0.20	5	3
	10-60	2.0-6.0	0.12-0.17	5.6-8.4	<2	Low-------	0.20		
7C*:									
Vebar-----------	0-29	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low-------	0.20	4	3
	29-34	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-------	0.20		
	34-60	---	---	---	---	----------	----		
Flasher---------	0-6	6.0-20	0.13-0.17	6.6-8.4	<2	Low-------	0.24	2	3
	6-17	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17		
	17-60	---	---	---	---	----------	----		
8*, 8B*:									
Belfield--------	0-9	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.32	3	6
	9-20	0.06-0.2	0.14-0.18	6.6-7.8	<2	High------	0.32		
	20-60	0.06-0.2	0.13-0.16	7.9-9.0	4-16	High------	0.32		
Savage----------	0-6	0.6-2.0	0.22-0.24	6.1-7.8	<2	Moderate	0.37	5	6
	6-15	0.06-0.6	0.12-0.20	6.6-7.8	<2	High------	0.37		
	15-36	0.06-0.6	0.12-0.20	7.4-8.4	2-4	High------	0.37		
	36-60	0.06-0.6	0.12-0.20	7.4-8.4	4-8	High------	0.37		
Daglum----------	0-8	0.6-2.0	0.16-0.18	5.6-7.3	<2	Moderate	0.32	3	6
	8-18	<0.2	0.12-0.14	6.1-9.0	2-8	High------	0.32		
	18-60	<0.2	0.12-0.14	7.9-9.0	8-16	High------	0.32		
9B---------------- Regent	0-7	0.06-0.2	0.17-0.20	6.1-7.8	<2	High------	0.32	4	7
	7-36	0.06-0.2	0.17-0.20	7.4-9.0	<8	High------	0.32		
	36-60	---	---	---	---	----------	----		
9C*:									
Regent----------	0-5	0.06-0.2	0.17-0.20	6.1-7.8	<2	High------	0.32	4	7
	5-25	0.06-0.2	0.17-0.20	7.4-9.0	<8	High------	0.32		
	25-60	---	---	---	---	----------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
9C*:									
Cabba-----------	0-4	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	2	4L
	4-17	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	17-60	---	---	---	---	----------	----		
10B*:									
Beisigl---------	0-5	6.0-20	0.11-0.13	6.6-8.4	<2	Low-------	0.17	4	2
	5-27	6.0-20	0.05-0.10	7.4-8.4	<2	Low-------	0.17		
	27-60	---	---	---	---	----------	----		
Lihen-----------	0-18	6.0-20	0.10-0.12	6.1-7.8	<2	Low-------	0.17	5	2
	18-60	6.0-20	0.06-0.10	7.4-8.4	<2	Low-------	0.17		
10D*:									
Beisigl---------	0-5	6.0-20	0.11-0.13	6.6-8.4	<2	Low-------	0.17	4	2
	5-27	6.0-20	0.05-0.10	7.4-8.4	<2	Low-------	0.17		
	27-60	---	---	---	---	----------	----		
Flasher---------	0-3	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17	2	2
	3-17	6.0-20	0.08-0.12	6.6-8.4	<2	Low-------	0.17		
	17-60	---	---	---	---	----------	----		
11B-------------- Moreau	0-4	0.06-0.2	0.15-0.18	7.4-9.0	<2	High------	0.32	4	4
	4-28	0.06-0.2	0.14-0.17	7.4-9.0	<4	High------	0.32		
	28-34	0.06-0.2	0.13-0.15	7.4-9.0	2-16	High------	0.32		
	34-60	---	---	---	---	----------	----		
12B*:									
Rhoades---------	0-3	0.6-2.0	0.15-0.17	5.6-7.3	<2	Moderate	0.32	3	6
	3-24	<0.2	0.10-0.12	>6.5	2-16	High------	0.32		
	24-60	<0.2	0.10-0.12	>7.3	8-16	High------	0.32		
Daglum----------	0-7	0.6-2.0	0.16-0.18	5.6-7.3	<2	Moderate	0.32	3	6
	7-18	<0.2	0.12-0.14	6.1-9.0	2-8	High------	0.32		
	18-60	<0.2	0.12-0.14	7.9-9.0	8-16	High------	0.32		
13--------------- Lawther	0-10	0.06-0.2	0.14-0.17	6.6-8.4	<2	High------	0.32	5	4
	10-33	0.06-0.2	0.14-0.17	7.4-9.0	<4	High------	0.32		
	33-60	0.06-0.2	0.14-0.17	7.9-9.0	4-12	High------	0.32		
14B-------------- Parshall	0-10	2.0-6.0	0.16-0.18	5.6-8.4	<2	Low-------	0.20	5	3
	10-60	2.0-6.0	0.12-0.17	5.6-8.4	<2	Low-------	0.20		
15--------------- Arnegard	0-9	0.6-2.0	0.20-0.24	6.1-7.3	<2	Moderate	0.28	5	6
	9-31	0.6-2.0	0.16-0.22	6.1-7.8	<2	Moderate	0.28		
	31-60	0.6-2.0	0.14-0.18	6.6-8.4	<2	Low-------	0.28		
16, 16B---------- Shambo	0-9	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low-------	0.28	5	6
	9-25	0.6-2.0	0.17-0.19	6.6-8.4	<2	Moderate	0.28		
	25-60	0.6-2.0	0.17-0.19	7.4-9.0	<2	Moderate	0.28		
17B-------------- Sen	0-6	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.32	4	6
	6-33	0.6-2.0	0.16-0.22	6.6-9.0	<2	Moderate	0.43		
	33-60	---	---	---	---	----------	----		
17C*, 17D*:									
Chama-----------	0-8	0.6-2.0	0.20-0.24	6.6-8.4	<2	Moderate	0.32	4	4L
	8-33	0.6-2.0	0.18-0.20	7.4-9.0	<2	Moderate	0.43		
	33-60	---	---	---	---	----------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
17C*, 17D*:									
Cabba-----------	0-6	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	2	4L
	6-16	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	16-60	---	---	---	---	----------	----		
18B-------------	0-8	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.28	4	6
Amor	8-36	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	36-60	---	---	---	---	----------	----		
18C*, 18D*:									
Amor------------	0-8	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.28	4	6
	8-36	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	36-60	---	---	---	---	----------	----		
Cabba-----------	0-6	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	2	4L
	6-17	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	17-60	---	---	---	---	----------	----		
19F*:									
Cabba-----------	0-4	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	2	4L
	4-17	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	17-60	---	---	---	---	----------	----		
Chama-----------	0-6	0.6-2.0	0.20-0.24	6.6-8.4	<2	Moderate	0.32	4	4L
	6-33	0.6-2.0	0.18-0.20	7.4-9.0	<2	Moderate	0.43		
	33-60	---	---	---	---	----------	----		
20F*:									
Flasher---------	0-3	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17	2	8
	3-17	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17		
	17-60	---	---	---	---	----------	----		
Beisigl---------	0-5	6.0-20	0.11-0.13	6.6-8.4	<2	Low--------	0.17	4	8
	5-27	6.0-20	0.05-0.10	7.4-8.4	<2	Low--------	0.17		
	27-60	---	---	---	---	----------	----		
Lihen-----------	0-18	6.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17	5	2
	18-60	6.0-20	0.06-0.10	7.4-8.4	<2	Low--------	0.17		
21---------------	0-10	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low--------	0.20	4	3
Ruso	10-29	2.0-6.0	0.11-0.15	6.6-7.3	<2	Low--------	0.20		
	29-60	>20	0.02-0.04	7.4-8.4	<2	Low--------	0.10		
22, 22B----------	0-5	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low--------	0.28	4	6
Bowdle	5-26	0.6-2.0	0.18-0.20	6.1-8.4	<2	Low--------	0.28		
	26-31	0.6-2.0	0.15-0.18	7.4-8.4	<2	Low--------	0.28		
	31-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low--------	0.10		
23F*:									
Flasher---------	0-3	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17	2	2
	3-17	6.0-20	0.08-0.12	6.6-8.4	<2	Low--------	0.17		
	17-60	---	---	---	---	----------	----		
Beisigl---------	0-5	6.0-20	0.11-0.13	6.6-8.4	<2	Low--------	0.17	4	2
	5-27	6.0-20	0.05-0.10	7.4-8.4	<2	Low--------	0.17		
	27-60	---	---	---	---	----------	----		
Rock outcrop.									
24---------------	0-18	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low--------	0.32	5	5
Straw	18-60	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.32		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
25B---------------- Lihen	0-18	6.0-20	0.10-0.12	6.1-7.8	<2	Low--------	0.17	5	2
	18-60	6.0-20	0.06-0.10	7.4-8.4	<2	Low--------	0.17		
26---------------- Regan	0-20	0.2-2.0	0.16-0.22	7.4-8.4	<4	Moderate	0.32	5	4L
	20-60	0.2-2.0	0.14-0.17	7.4-9.0	<8	Moderate	0.32		
27E*:									
Sinnigam----------	0-2	0.6-2.0	0.11-0.13	6.1-7.8	<2	Low--------	0.10	1	8
	2-13	0.2-0.6	0.07-0.08	6.1-7.8	<2	Moderate	0.05		
	13-24	---	---	---	---	-----------	----		
Daglum------------	0-8	0.6-2.0	0.16-0.18	5.6-7.3	<2	Moderate	0.32	3	6
	8-18	<0.2	0.12-0.14	6.1-9.0	2-8	High------	0.32		
	18-34	<0.2	0.12-0.14	7.9-9.0	8-16	High------	0.32		
	34-60	---	---	---	---	-----------	----		
28---------------- Harriet	0-3	0.06-0.2	0.20-0.24	6.6-8.4	<2	Moderate	0.37	3	6
	3-16	<0.06	0.10-0.15	>7.3	4-16	High------	0.37		
	16-60	0.06-0.2	0.10-0.15	>7.8	4-16	Moderate	0.37		
29---------------- Korchea	0-9	0.6-2.0	0.17-0.21	6.6-8.4	<2	Low--------	0.28	5	5
	9-60	0.6-2.0	0.16-0.18	7.4-9.0	<2	Moderate	0.28		
30---------------- Straw	0-18	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low--------	0.32	5	5
	18-60	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.32		
31B--------------- Watrous	0-6	0.6-2.0	0.20-0.24	6.1-7.8	<2	Moderate	0.28	4	6
	6-27	0.6-2.0	0.15-0.19	6.1-7.8	<2	Moderate	0.28		
	27-33	---	---	---	---	-----------	----		
32*. Dumps-Pits									
33B--------------- Savage	0-6	0.6-2.0	0.18-0.23	6.1-7.8	<2	Moderate	0.37	5	7
	6-15	0.06-0.6	0.12-0.20	6.6-7.8	<2	High------	0.37		
	15-36	0.06-0.6	0.12-0.20	7.4-8.4	2-4	High------	0.37		
	36-60	0.06-0.6	0.12-0.20	7.4-8.4	4-8	High------	0.37		
34F*:									
Cabba-------------	0-4	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	2	4L
	4-17	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.28		
	17-60	---	---	---	---	-----------	----		
Brandenburg-------	0-18	0.6-2.0	0.18-0.20	6.6-7.8	<2	Low--------	0.24	2	8
	18-60	>20	0.01-0.03	6.6-8.4	<2	Low--------	0.10		
Savage------------	0-6	0.6-2.0	0.18-0.23	6.1-7.8	<2	Moderate	0.37	5	7
	6-15	0.06-0.6	0.12-0.20	6.6-7.8	<2	High------	0.37		
	15-36	0.06-0.6	0.12-0.20	7.4-8.4	2-4	High------	0.37		
	36-60	0.06-0.6	0.12-0.20	7.4-8.4	4-8	High------	0.37		
35F*:									
Cabba-------------	0-4	0.6-2.0	0.12-0.16	6.6-8.4	<4	Low--------	0.17	2	8
	4-17	0.6-2.0	0.14-0.18	7.4-9.0	2-8	Moderate	0.32		
	17-60	---	---	---	---	-----------	----		
Amor--------------	0-8	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	0.20	4	8
	8-36	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	36-60	---	---	---	---	-----------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
35F*:									
Savage----------	0-6	0.6-2.0	0.18-0.23	6.1-7.8	<2	Moderate	0.37	5	7
	6-15	0.06-0.6	0.12-0.20	6.6-7.8	<2	High------	0.37		
	15-36	0.06-0.6	0.12-0.20	7.4-8.4	2-4	High------	0.37		
	36-60	0.06-0.6	0.12-0.20	7.4-8.4	4-8	High------	0.37		
36--------------- Velva	0-4	0.6-6.0	0.13-0.22	6.6-7.8	<2	Low-------	0.20	5	3
	4-60	0.6-6.0	0.16-0.22	6.6-8.4	<2	Low-------	0.20		
37B-------------- Ekalaka	0-17	2.0-6.0	0.13-0.20	5.1-8.4	<2	Low-------	0.24	3	3
	17-24	0.06-0.2	0.11-0.13	7.4-9.0	2-8	Low-------	0.24		
	24-45	0.06-6.0	0.06-0.08	7.4-9.0	4-16	Low-------	0.24		
	45-60	---	---	---	---	-----------	----		
41--------------- Grail	0-9	0.2-0.6	0.09-0.10	6.1-8.4	8-16	Moderate	0.32	5	7
	9-27	0.06-0.2	0.07-0.09	6.6-8.4	8-16	High------	0.32		
	27-60	0.06-0.2	0.06-0.11	7.4-8.4	8-16	Moderate	0.32		
51--------------- Parshall	0-10	2.0-6.0	0.08-0.09	6.6-8.4	8-16	Low-------	0.20	5	3
	10-60	2.0-6.0	0.06-0.09	6.6-8.4	8-16	Low-------	0.20		
61--------------- Arnegard	0-9	0.6-2.0	0.10-0.12	6.1-7.3	8-16	Moderate	0.28	5	6
	9-31	0.6-2.0	0.08-0.11	6.1-7.8	8-16	Moderate	0.28		
	31-60	0.6-2.0	0.07-0.09	6.6-8.4	8-16	Low-------	0.28		
81*:									
Belfield--------	0-9	0.6-2.0	0.10-0.12	6.1-7.3	8-16	Moderate	0.32	3	6
	9-20	0.06-0.2	0.07-0.09	6.6-7.8	8-16	High------	0.32		
	20-60	0.06-0.2	0.06-0.08	7.9-9.0	8-16	High------	0.32		
Savage----------	0-6	0.6-2.0	0.11-0.12	6.6-7.8	8-16	High------	0.37	5	6
	6-15	0.06-0.2	0.06-0.10	6.6-7.8	8-16	High------	0.37		
	15-36	0.06-0.2	0.06-0.10	7.4-8.4	8-16	High------	0.37		
	36-60	0.06-0.2	0.06-0.10	7.4-8.4	8-16	High------	0.37		
Daglum----------	0-8	0.6-2.0	0.08-0.09	5.6-7.3	8-16	Moderate	0.32	3	6
	8-18	<0.2	0.06-0.07	6.1-9.0	8-16	High------	0.32		
	18-60	<0.2	0.06-0.07	7.9-9.0	8-16	High------	0.32		

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

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "occasional," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
2 Heil	D	None	---	---	+1-1.0	Apparent	Mar-Sep	>60	---	Moderate	High	Moderate.
3 Dimmick	D	None	---	---	+1-2.0	Apparent	Apr-Jul	>60	---	Moderate	High	Low.
4 Grail	C	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
5C Wayden	D	None	---	---	>6.0	---	---	10-20	Soft	Low	High	Moderate.
6B*:												
Vebar	B	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Parshall	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
7C*:												
Vebar	B	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Flasher	D	None	---	---	>6.0	---	---	7-20	Soft	Low	Moderate	Low.
8*, 8B*:												
Belfield	C	None	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
Savage	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Daglum	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
9B Regent	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Moderate.
9C*:												
Regent	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Moderate.

See footnote at end of table.

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

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
9C*:												
Cabba	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Low.
10B*:												
Beisigl	A	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Lihen	A	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
10D*:												
Beisigl	A	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Flasher	D	None	---	---	>6.0	---	---	7-20	Soft	Low	Moderate	Low.
11B Moreau	D	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
12B*:												
Rhoades	D	None	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
Daglum	D	None	---	---	>6.0	---	---	>60	---	Moderate	High	Moderate.
13 Lawther	D	None	---	---	>6.0	---	---	>60	---	Low	High	High.
14B Parshall	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
15 Arnegard	B	None	---	---	>6.0	---	---	>60	---	Moderate	High	Low.
16, 16B Shambo	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
17B Sen	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Moderate.
17C*, 17D*:												
Chama	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Low.

See footnote at end of table.

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

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
17C*, 17D*:												
Cabba	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Low.
18B Amor	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Moderate.
18C*, 18D*:												
Amor	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Moderate.
Cabba	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Low.
19F*:												
Cabba	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Low.
Chama	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Low.
20F*:												
Flasher	D	None	---	---	>6.0	---	---	7-20	Soft	Low	Moderate	Low.
Beisigl	A	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Lihen	A	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
21 Ruso	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
22, 22B Bowdle	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
23F*:												
Flasher	D	None	---	---	>6.0	---	---	7-20	Soft	Low	Moderate	Low.
Beisigl	A	None	---	---	>6.0	---	---	20-40	Soft	Low	Moderate	Low.
Rock outcrop.												
24 Straw	B	Occasional	Brief	Mar-May	>6.0	---	---	>60	---	Moderate	High	Low.

See footnote at end of table.

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

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
25B: Lihen	A	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
26: Regan	B/D	Occasional	Brief to long.	Mar-Jun	0-1.0	Apparent	Oct-Jun	>60	---	High	High	Low.
27E*:												
Sinnigam	D	None	---	---	>6.0	---	---	10-20	Hard	Moderate	Moderate	Low.
Daglum	D	None	---	---	>6.0	---	---	40-60	Soft	Moderate	High	Moderate.
28: Harriet	D	Occasional	Long	Apr-Jun	0-1.0	Apparent	Sep-Jun	>60	---	High	High	Moderate.
29: Korchea	B	Occasional	Very brief to brief.	Mar-Jun	>6.0	---	---	>60	---	Moderate	High	Moderate.
30: Straw	B	Frequent	Brief	Mar-May	>6.0	---	---	>60	---	Moderate	High	Low.
31B: Watrous	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	High	Low.
32*. Dumps-Pits												
33B: Savage	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
34F*:												
Cabba	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Low.
Brandenburg	A	None	---	---	>6.0	---	---	>60	---	Low	High	Moderate.
Savage	C	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
35F*:												
Cabba	D	None	---	---	>6.0	---	---	10-20	Soft	Moderate	High	Low.

See footnote at end of table.

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

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
35F*:												
Amor-------------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Moderate.
Savage-----------	C	None---------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
36---------------- Velva	B	Occasional	Very brief to brief.	Mar-Jun	>6.0	---	---	>60	---	Moderate	High-----	Low.
37B--------------- Ekalaka	B	None---------	---	---	>6.0	---	---	40-60	Soft	Moderate	High-----	Moderate.
41---------------- Grail	C	None---------	---	---	4.0-6.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Moderate.
51---------------- Parshall	B	None---------	---	---	4.0-6.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Moderate.
61---------------- Arnegard	B	None---------	---	---	4.0-6.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Moderate.
81*:												
Belfield---------	C	None---------	---	---	4.0-6.0	Apparent	Oct-Jun	>60	---	Low------	High-----	Moderate.
Savage-----------	C	None---------	---	---	4.0-6.0	Apparent	Oct-Jun	>60	---	Low------	High-----	Moderate.
Daglum-----------	D	None---------	---	---	4.0-6.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Moderate.

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

TABLE 17.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available. LL means liquid limit; PI, plasticity index; MD, maximum dry density; OM, optimum moisture; and NP, nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution										Moisture density	
			Percentage passing sieve--					Percentage smaller than--			LL	PI	MD	OM
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
											Pct		Lb/ft3	Pct
Amor loam: (S77ND001-008)														
Bw------ 9 to 15	A-4(4)	CL-ML	100	100	99	99	57	---	20	---	27	7	124	11
2Bk-----23 to 30	A-6(11)	CL	100	100	100	100	92	---	48	---	38	17	117	14
Beisigl loamy fine sand: (S77ND001-011)														
Bk1-----12 to 20	A-2-4(0)	SM	100	100	99	99	31	---	8	---	---	NP	115	15
Cr------27 to 40	A-2-4(0)	SM	100	100	100	100	22	---	4	---	---	NP	115	15
Bowdle loam: (S79ND001-021)														
Bw1----- 5 to 15	A-6-4(4)	CL	97	96	91	74	52	---	15	---	31	12	126	10
2C2-----36 to 60	A-1-6(0)	SM	87	73	52	31	14	---	3	---	---	NP	130	9
Flasher loamy fine sand: (S78ND001-019)														
AC------ 3 to 15	A-2-4(0)	SM	91	89	85	85	24	---	5	---	---	NP	118	14
Cr------15 to 60	A-2-4(0)	SM	100	100	100	100	21	---	2	---	---	NP	104	18
Grail clay loam: (S77ND001-009)														
Bt2-----20 to 29	A-6(10)	CL	100	100	100	99	77	---	39	---	36	15	121	12
3Bt-----46 to 53	A-6(12)	CL	100	100	99	98	82	---	41	---	39	21	120	13
Lawther silty clay: (S77ND001-006)														
Bw1-----10 to 21	A-7-6(15)	CL	100	100	100	100	97	---	55	---	48	22	110	16
C2------47 to 63	A-6(11)	CL	100	100	100	100	93	---	47	---	38	17	120	13
Lihen loamy fine sand: (S77ND001-012)														
Bk1-----18 to 30	A-2-4(0)	SM	100	100	100	100	26	---	8	---	---	NP	115	14
C-------45 to 60	A-2-4(0)	SM	100	100	100	100	27	---	10	---	---	NP	118	14
Moreau silty clay: (S77ND001-005)														
Bk1-----15 to 21	A-7-6(13)	CL	100	100	100	100	98	---	67	---	47	21	114	15
Cr1-----28 to 34	A-7-6(17)	CL	100	100	100	99	97	---	65	---	49	27	117	14

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								LL	PI	Moisture density	
			Percentage passing sieve--					Percentage smaller than--					MD	OM
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
											Pct		Lb/ft3	Pct
Sinnigam very stony loam:														
(S80ND001-027)														
Bt2----- 6 to 13	A-2-7(1)	SC	43	37	32	30	22	---	14	---	45	22	112	15
Straw loam:														
(S79ND001-024)														
C1------18 to 28	A-6(6)	CL	99	98	93	93	63	---	25	---	26	11	126	11
C2------28 to 56	A-6(9)	CL	100	100	100	100	79	---	22	---	29	13	119	13
Vebar fine sandy loam:														
(S79ND001-025)														
Bk1-----13 to 22	A-4(2)	SM	99	97	91	89	44	---	11	---	---	NP	116	14
Cr1-----27 to 46	A-2-4(0)	SM	100	100	100	99	21	---	2	---	---	NP	116	14

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates a taxadjunct to the series. See notes for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Amor	Fine-loamy, mixed Typic Haploborolls
Arnegard	Fine-loamy, mixed Pachic Haploborolls
Beisigl	Mixed, frigid Typic Ustipsamments
Belfield	Fine, montmorillonitic Glossic Natriborolls
Bowdle	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Haploborolls
Brandenburg	Fragmental, mixed, frigid Typic Ustorthents
Cabba	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Chama	Fine-silty, mixed Entic Haploborolls
Daglum	Fine, montmorillonitic Typic Natriborolls
Dimmick	Fine, montmorillonitic, frigid Typic Haplaquolls
Ekalaka	Coarse-loamy, mixed Typic Natriborolls
Flasher	Mixed, frigid, shallow Typic Ustipsamments
Grail	Fine, montmorillonitic Pachic Argiborolls
Harriet	Fine, mixed, frigid Typic Natraquolls
Heil	Fine, montmorillonitic, frigid Typic Natraquolls
Korchea	Fine-loamy, mixed (calcareous), frigid Mollic Ustifluvents
Lawther	Fine, montmorillonitic Vertic Haploborolls
Lihen	Sandy, mixed Entic Haploborolls
*Moreau	Fine, montmorillonitic Typic Haploborolls
Parshall	Coarse-loamy, mixed Pachic Haploborolls
*Regan	Fine-silty, frigid Typic Calciaquolls
Regent	Fine, montmorillonitic Typic Argiborolls
Rhoades	Fine, montmorillonitic Leptic Natriborolls
Ruso	Coarse-loamy, mixed Pachic Haploborolls
Savage	Fine, montmorillonitic Typic Argiborolls
Sen	Fine-silty, mixed Typic Haploborolls
Shambo	Fine-loamy, mixed Typic Haploborolls
Sinnigam	Clayey-skeletal, mixed Lithic Argiborolls
Straw	Fine-loamy, mixed Cumulic Haploborolls
Vebar	Coarse-loamy, mixed Typic Haploborolls
Velva	Coarse-loamy, mixed Fluventic Haploborolls
Watrous	Fine-loamy, mixed Typic Argiborolls
Wayden	Clayey, montmorillonitic (calcareous), frigid, shallow Typic Ustorthents

☆ U.S. GOVERNMENT PRINTING OFFICE : 1987 O - 493-534 : QL 3

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.