United States Department of Agriculture

Natural Resources Conservation Service

United States Department of the Interior

National Park Service

Soil Survey of Washita Battlefield National Historic Site, Oklahoma

How To Use This Soil Survey

This publication consists of text, tables, and a map. The text includes descriptions of detailed soil map units and provides an explanation of the information presented in the tables. It also includes a glossary of terms used in the text and tables and a list of references.

The detailed soil map can be useful in planning the use and management of small areas. To find information about your area of interest, locate that area on the map sheet. Note the map unit symbols that are in that area. Go to the Contents, which lists the map units by symbol and name and shows where each map unit is described.

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

National Cooperative Soil Survey

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Soil names and descriptions for this soil survey were approved in February 1961. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in March 2010. This survey was made cooperatively by the Natural Resources Conservation Service and the National Park Service.

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

Literature Citation

The correct citation for this survey is as follows:

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Cover Caption

The rolling red plains in Washita Battlefield National Historic Site have soils that formed predominantly in alluvium. The landscape is a result of erosional processes, mainly the downcutting and redeposition by rivers.

Additional information about the Nation's natural resources is available online from the Natural Resources Conservation Service at http://www.nrcs.usda.gov/.

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Contents

Issued 2015

Preface

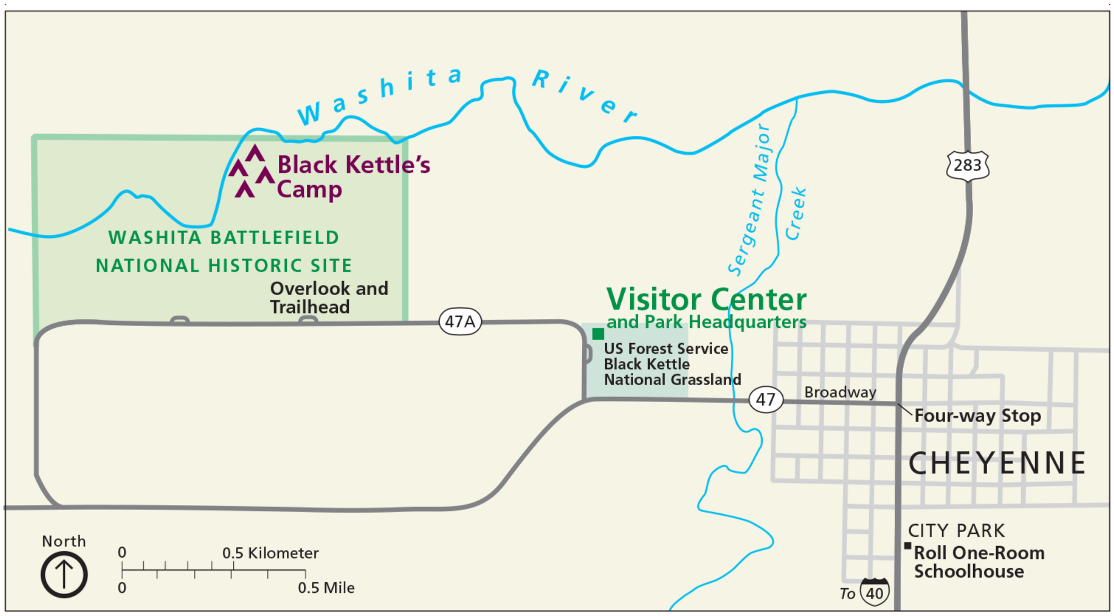
This soil survey was developed in conjunction with the National Park Service's Soil Inventory and Monitoring Program and is intended to serve as the official source document for soils occurring within Washita Battlefield National Historic Site, Oklahoma.

This soil survey contains information that affects current and future land use planning in the park. It contains predictions of soil behavior for selected land uses. The survey highlights soil limitations, actions needed to overcome the limitations, and the impact of selected land uses on the environment. It is designed to meet the needs of the National Park Service and its partners to better understand the properties of the soils in the park and the effects of these properties on various natural ecological characteristics. This knowledge can help the National Park Service and its partners to understand, protect, and enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

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. The location of each map unit is shown on the detailed soil map. Each soil in the survey area is described, and information on specific uses is given. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the park office for Washita Battlefield National Historic Site.



Map of Washita Battlefield National Historic Site, Oklahoma.

Soil Survey of
Washita Battlefield National Historic Site, Oklahoma

United States Department of Agriculture, Natural Resources Conservation Service, and United States Department of the Interior, National Park Service

How This Survey Was Made

This survey was made in conjunction with the National Park Service's Soil Inventory and Monitoring Program to provide information about the soils and miscellaneous areas within Washita Battlefield National Historic Site.

The soil survey for the park was clipped from the soil survey of Roger Mills County, Oklahoma, which was correlated in February 1961. Mapping was performed at a scale of 1:24,000. In March 2010, the soils data was reposted to the Soil Data Mart with edits to the attribute data but no edits were made to the spatial data. At the time this document was assembled (January 2013), the area of Washita Battlefield National Historic Site had 14 different map units comprised of 45 map unit components.

Sections of this report were reviewed by State-based staff of the Natural Resources Conservation Service.

During the soil survey, soil component relationships were observed. Soil-site correlation concepts were established to help in designing the map units. Soil and plant specialists tested the concepts during mapping and collected field documentation at numerous points across the landscape. Ecological sites were assigned to most, but not all, of the soil components in each map unit.

The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general patterns of drainage; the kinds of native plants; 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 biological activity.

The soils and miscellaneous areas in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area 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-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units).

Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict 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 delineated the boundaries of these bodies on digital imagery and identified each as a specific map unit.

Detailed Soil Map Units

The map units delineated on the detailed soil map in this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the map, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. 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 other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties 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, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The contrasting components are mentioned in the map unit descriptions. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit 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, 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, slope, stoniness, salinity, 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, Lincoln fine sandy loam, 0 to 1 percent slopes, frequently flooded, is a phase of the Lincoln series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes. A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Grandfield-Devol complex, 3 to 5 percent slopes, is an example.

Table 1 lists each map unit in the park, its major and minor components, and the percentage of each component in the unit. Other 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 or miscellaneous areas.

384742—Lincoln fine sandy loam, 0 to 1 percent slopes, frequently flooded

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 695 to 2,195 feet
Mean annual precipitation: 22 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Lincoln and similar soils: 95 percent
Dissimilar minor components: 5 percent

Description of the Lincoln Soil

Classification
Soil taxonomic classification: Sandy, mixed, thermic Typic Ustifluvents
Ecological site name and identification: Sandy Bottomland 23-30” PZ (R078CY068OK)

Setting
Landscape: Valleys
Landform: Flood plains
Slope range: 0 to 2 percent
Down-slope shape: Linear
Across-slope shape: Linear
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Negligible
Parent material: Calcareous sandy alluvium
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Somewhat excessively drained

Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 3
Available water capacity: Low (about 4.9 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 5w
Meets hydric soil criteria: No
Hydrologic soil group: A

Vegetation
Existing plants: Sand bluestem, threeawn, switchgrass, Texas bluegrass, little bluestem, Indiangrass, other perennial forbs and grasses, and trees

Typical Profile
A—0 to 12 inches; fine sandy loam
C—12 to 80 inches; stratified fine sand to clay loam

Minor Components

Ezell soils
Percent of map unit: 5 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: Yes

384751—Grandfield-Nobscot complex, 5 to 8 percent slopes

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 1,000 to 2,495 feet
Mean annual precipitation: 20 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Grandfield and similar soils: 70 percent
Nobscot and similar soils: 20 percent
Dissimilar minor components: 10 percent

Description of the Grandfield Soil

Classification
Soil taxonomic classification: Fine-loamy, mixed, superactive, thermic Typic Haplustalfs
Ecological site name and identification: Sandy Loam Prairie 23-31” PZ (R078CY110TX)

Setting
Landscape: Uplands

Landform: Sand sheets on paleoterraces
Landform position (three-dimensional): Riser
Slope range: 5 to 8 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Medium
Parent material: Loamy alluvium and/or eolian deposits
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 3
Available water capacity: High (about 10.6 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 4e
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Sideoats grama, little bluestem, blue grama, buffalograss, sand lovegrass, sand bluestem, switchgrass, other perennial grasses and forbs, and trees

Typical Profile
A—0 to 6 inches; fine sandy loam
Bt1—6 to 12 inches; fine sandy loam
Bt2—12 to 32 inches; sandy clay loam
C—32 to 80 inches; fine sandy loam

Description of the Nobscot Soil

Classification
Soil taxonomic classification: Loamy, mixed, superactive, thermic Arenic Paleustalfs
Ecological site name and identification: Shinnery Oak Grassland 21 - 28 PZ (R078CY017OK)

Setting
Landscape: Dune fields, sandhills, and uplands
Landform: Dunes
Slope range: 5 to 8 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects

Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Low
Parent material: Sandy and loamy alluvium and/or eolian deposits
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 0
Available water capacity: Moderate (about 6.2 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 4e
Meets hydric soil criteria: No
Hydrologic soil group: A

Vegetation
Existing plants: Sand bluestem, other perennial grasses, Scribner panicum, switchgrass, little bluestem, Indiangrass, dropseed, other perennial forbs, shrubs, and trees

Typical Profile
A—0 to 5 inches; loamy fine sand
E—5 to 34 inches; fine sand
Bt1—34 to 44 inches; fine sandy loam
Bt2—44 to 54 inches; loamy fine sand
BC—54 to 70 inches; fine sand

Minor Components

Devol soils
Percent of map unit: 5 percent
Landform: Dunes on sand sheets on stream terraces
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 5 to 8 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

Eda soils
Percent of map unit: 5 percent
Landform: Dunes
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 5 to 8 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384753—Grandfield-Devol complex, 3 to 5 percent slopes

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 1,000 to 2,995 feet
Mean annual precipitation: 20 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Grandfield and similar soils: 55 percent
Devol and similar soils: 40 percent
Dissimilar minor components: 5 percent

Description of the Grandfield Soil

Classification
Soil taxonomic classification: Fine-loamy, mixed, superactive, thermic Typic Haplustalfs
Ecological site name and identification: Sandy Loam Prairie 23-31" PZ (R078CY110TX)

Setting
Landscape: Uplands
Landform: Sand sheets on paleoterraces
Landform position (three-dimensional): Riser
Slope range: 3 to 5 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Low
Parent material: Loamy alluvium and/or eolian deposits
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 3
Available water capacity: High (about 10.6 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 3e
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation

Existing plants: Sideoats grama, little bluestem, blue grama, buffalograss, sand lovegrass, sand bluestem, switchgrass, other perennial grasses and forbs, and trees

Typical Profile

A—0 to 6 inches; fine sandy loam
Bt1—6 to 12 inches; fine sandy loam
Bt2—12 to 32 inches; sandy clay loam
C—32 to 80 inches; fine sandy loam

Description of the Devol Soil

Classification

Soil taxonomic classification: Coarse-loamy, mixed, superactive, thermic Typic Haplustalfs
Ecological site name and identification: Sandy Loam Prairie 23-31" PZ (R078CY110TX)

Setting

Landscape: Alluvial plains
Landform: Dunes on sand sheets on stream terraces
Slope range: 3 to 5 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities

Runoff: Very low
Parent material: Coarse-loamy alluvium and/or sandy eolian deposits
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 1
Available water capacity: Moderate (about 7.8 inches)
Gypsum maximum: None

Interpretive Groups

Land capability subclass (nonirrigated areas): 3e
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation

Existing plants: Sideoats grama, little bluestem, blue grama, buffalograss, sand lovegrass, sand bluestem, switchgrass, other perennial grasses and forbs, and trees

Typical Profile
A—0 to 14 inches; fine sandy loam
Bt—14 to 36 inches; fine sandy loam
C—36 to 72 inches; loamy fine sand

Minor Components

Hardeman soils
Percent of map unit: 3 percent
Landform: Hills on sand sheets
Geomorphic position (two-dimensional): Backslope
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 3 to 5 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

Eda soils
Percent of map unit: 2 percent
Landform: Dunes
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 3 to 5 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384758—Clairemont silt loam, 0 to 1 percent slopes, occasionally flooded

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 695 to 2,250 feet
Mean annual precipitation: 20 to 32 inches
Mean annual air temperature: 57 to 65 degrees F
Frost-free period: 185 to 240 days

Map Unit Composition

Clairemont and similar soils: 95 percent
Dissimilar minor components: 5 percent

Description of the Clairemont Soil

Classification
Soil taxonomic classification: Fine-silty, mixed, superactive, calcareous, thermic Typic Ustifluvents
Ecological site name and identification: Loamy Bottomland 23-31” PZ (R078CY103TX)

Setting
Landscape: Valleys
Landform: Flood plains
Slope range: 0 to 1 percent
Down-slope shape: Linear

Across-slope shape: Linear
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Negligible
Parent material: Calcareous silty alluvium
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Sodium adsorption ratio of 2.0
Calcium carbonate equivalent (maximum weight percentage): 8
Available water capacity: High (about 11.4 inches)
Gypsum maximum: About 2 percent

Interpretive Groups
Land capability subclass: Nonirrigated areas—2e; irrigated areas—1
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Big bluestem, Indiangrass, switchgrass, eastern gamagrass, Florida paspalum, little bluestem, other perennial grasses and forbs, shrubs, and trees

Typical Profile
A—0 to 22 inches; silt loam
C—22 to 60 inches; silt loam

Minor Components

Westola soils
Percent of map unit: 3 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: No

Lincoln soils
Percent of map unit: 2 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: No

384760—Eda sand, 0 to 3 percent slopes MLRA 78C

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 980 to 2,590 feet
Mean annual precipitation: 22 to 31 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Eda and similar soils: 90 percent
Dissimilar minor components: 10 percent

Description of the Eda Soil

Classification
Soil taxonomic classification: Mixed, thermic Lamellic Ustipsamments
Ecological site name and identification: Shinnery Oak Grassland 21 - 28 PZ (R078CY017OK)

Setting
Landscape: Dune fields
Landform: Dunes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Slope range: 0 to 3 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Negligible
Parent material: Eolian sands
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Somewhat excessively drained
Shrink-swell potential: Low (about 0.4 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 1
Available water capacity: Low (about 4.8 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated and irrigated areas): 3e
Meets hydric soil criteria: No
Hydrologic soil group: A

Vegetation

Existing plants: Scribner panicum, little bluestem, sand bluestem, switchgrass, Indiangrass, dropseed, other perennial forbs and grasses, shrubs, and trees

Typical Profile

Ap—0 to 11 inches; sand
E and Bt—11 to 35 inches; loamy sand
C—35 to 80 inches; fine sand

Minor Components

Devol soils

Percent of map unit: 4 percent
Landform: Dunes on sand sheets on paleoterraces
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 3 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

Carwile soils

Percent of map unit: 3 percent
Landform: Depressions
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 3 percent
Down-slope shape: Concave
Across-slope shape: Concave
Meets hydric soil criteria: Yes

Delwin soils

Percent of map unit: 1 percent
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 3 percent
Meets hydric soil criteria: No

Heatly soils

Percent of map unit: 1 percent
Landform: Interdunes on sand sheets on stream terraces
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 3 percent
Down-slope shape: Linear
Across-slope shape: Concave
Meets hydric soil criteria: No

Nobscot soils

Percent of map unit: 1 percent
Landform: Dunes on dune fields
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 3 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384762—Eda loamy fine sand, 8 to 12 percent slopes

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 695 to 2,495 feet
Mean annual precipitation: 18 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Eda and similar soils: 90 percent
Dissimilar minor components: 10 percent

Description of the Eda Soil

Classification
Soil taxonomic classification: Mixed, thermic Lamellic Ustipsamments
Ecological site name and identification: Deep Sand (R078CY014OK)

Setting
Landscape: Dune fields, sandhills, and uplands
Landform: Dunes
Slope range: 8 to 12 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Very low
Parent material: Eolian sands
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Somewhat excessively drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 1
Available water capacity: Low (about 5.8 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 6e
Meets hydric soil criteria: No
Hydrologic soil group: A

Vegetation
Existing plants: Sand bluestem, sand sagebrush, sideoats grama, sand lovegrass, switchgrass, little bluestem, Indiangrass, other perennial forbs and grasses, and shrubs

Typical Profile
A—0 to 10 inches; loamy fine sand
Bt—10 to 20 inches; loamy fine sand
C—20 to 80 inches; loamy fine sand

Minor Components

Devol soils
Percent of map unit: 5 percent
Landform: Dunes on sand sheets on stream terraces
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 8 to 12 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

Tivoli soils
Percent of map unit: 5 percent
Landform: Dunes
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 8 to 12 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384769—Quinlan-Woodward complex, 5 to 12 percent slopes

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 1,000 to 2,495 feet
Mean annual precipitation: 20 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Quinlan and similar soils: 65 percent
Woodward and similar soils: 30 percent
Dissimilar minor components: 5 percent

Description of the Quinlan Soil

Classification
Soil taxonomic classification: Loamy, mixed, superactive, thermic, shallow Typic Haplustepts
Ecological site name and identification: Shallow Prairie (North) 23-30 PZ (R078CY083OK)

Setting
Landscape: Uplands
Landform: Hillslopes on hills
Landform position (two-dimensional): Backslope
Slope range: 5 to 12 percent

Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: High
Parent material: Loamy residuum weathered from calcareous sandstone
Restrictive feature(s): Paralithic bedrock at a depth of 10 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 8
Available water capacity: Very low (about 2.2 inches)
Gypsum maximum: About 2 percent

Interpretive Groups
Land capability subclass (nonirrigated areas): 6e
Meets hydric soil criteria: No
Hydrologic soil group: C

Vegetation
Existing plants: Sand bluestem, sideoats grama, blue grama, buffalograss, little bluestem, sand dropseed, other perennial forbs and grasses, and shrubs

Typical Profile
A—0 to 6 inches; loam
Bw—6 to 13 inches; silt loam
Cr—13 to 20 inches; bedrock

Description of the Woodward Soil

Classification
Soil taxonomic classification: Coarse-silty, mixed, superactive, thermic Typic Haplustepts
Ecological site name and identification: Loamy Prairie 23-30 PZ (R078CY056OK)

Setting
Landscape: Uplands
Landform: Hillslopes on hills
Landform position (two-dimensional): Backslope
Slope range: 5 to 20 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Medium
Parent material: Loamy residuum weathered from calcareous sandstone
Restrictive feature(s): Paralithic bedrock at a depth of 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 9
Available water capacity: Low (about 4.7 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 6e
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Sand bluestem, sideoats grama, switchgrass, little bluestem, Indiangrass, other perennial forbs and grasses, and shrubs

Typical Profile
A—0 to 12 inches; loam
Bw—12 to 24 inches; silt loam
Cr—24 to 40 inches; bedrock

Minor Components

Cordell soils
Percent of map unit: 5 percent
Landform: Hillslopes on hills
Geomorphic position (two-dimensional): Backslope
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 8 to 15 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384775—Devol loamy fine sand, 3 to 8 percent slopes

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 1,000 to 2,495 feet
Mean annual precipitation: 20 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Devol and similar soils: 95 percent
Dissimilar minor components: 5 percent

Description of the Devol Soil

Classification
Soil taxonomic classification: Coarse-loamy, mixed, superactive, thermic Typic Haplustalfs
Ecological site name and identification: Deep Sand (R078CY014OK)

Setting
Landscape: Alluvial plains
Landform: Dunes on sand sheets on stream terraces
Slope range: 3 to 8 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Low
Parent material: Coarse-loamy alluvium and/or sandy eolian deposits
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 1
Available water capacity: Moderate (about 7.3 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 4e
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Sand bluestem, sand sagebrush, sideoats grama, sand lovegrass, switchgrass, little bluestem, Indiangrass, other perennial forbs and grasses, and shrubs

Typical Profile
A—0 to 14 inches; loamy fine sand
Bt—14 to 36 inches; fine sandy loam
C—36 to 72 inches; loamy fine sand

Minor Components

Eda soils
Percent of map unit: 5 percent
Landform: Dunes
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 3 to 8 percent

Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384776—Devol loamy fine sand, 8 to 12 percent slopes

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 695 to 2,495 feet
Mean annual precipitation: 18 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Devol and similar soils: 90 percent
Dissimilar minor components: 10 percent

Description of the Devol Soil

Classification
Soil taxonomic classification: Coarse-loamy, mixed, superactive, thermic Typic Haplustalfs
Ecological site name and identification: Deep Sand (R078CY014OK)

Setting
Landscape: Alluvial plains
Landform: Dunes on sand sheets on stream terraces
Slope range: 8 to 12 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Low
Parent material: Coarse-loamy alluvium and/or sandy eolian deposits
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 1
Available water capacity: Moderate (about 7.3 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 6e
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Sand bluestem, sand sagebrush, sideoats grama, sand lovegrass, switchgrass, little bluestem, Indiangrass, other perennial forbs and grasses, and shrubs

Typical Profile
A—0 to 14 inches; loamy fine sand
Bt—14 to 36 inches; fine sandy loam
C—36 to 72 inches; loamy fine sand

Minor Components

Eda soils
Percent of map unit: 5 percent
Landform: Dunes
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 8 to 12 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

Tivoli soils
Percent of map unit: 5 percent
Landform: Dunes
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 8 to 12 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384777—Port silt loam, 0 to 1 percent slopes, occasionally flooded

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 695 to 2,250 feet
Mean annual precipitation: 20 to 40 inches
Mean annual air temperature: 57 to 65 degrees F
Frost-free period: 185 to 240 days

Map Unit Composition

Port and similar soils: 90 percent
Dissimilar minor components: 10 percent

Description of the Port Soil

Classification
Soil taxonomic classification: Fine-silty, mixed, superactive, thermic Cumulic Haplustolls
Ecological site name and identification: Loamy Bottomland 23-31” PZ (R078CY103TX)

Setting
Landscape: Valleys
Landform: Flood plains

Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Negligible
Parent material: Calcareous loamy alluvium
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Moderate (about 4.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 1
Available water capacity: Very high (about 16.0 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 2w
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Big bluestem, Indiangrass, switchgrass, eastern gamagrass, Florida paspalum, little bluestem, other perennial grasses and forbs, shrubs, and trees

Typical Profile
A—0 to 13 inches; silt loam
AC—13 to 24 inches; silt loam
C—24 to 80 inches; silt loam

Minor Components

Clairemont soils
Percent of map unit: 5 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: No

Westola soils
Percent of map unit: 5 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent

Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: No

384784—Woodward fine sandy loam, 3 to 5 percent slopes

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 1,000 to 2,495 feet
Mean annual precipitation: 20 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Woodward and similar soils: 90 percent
Dissimilar minor components: 10 percent

Description of the Woodward Soil

Classification
Soil taxonomic classification: Coarse-silty, mixed, superactive, thermic Typic Haplustepts
Ecological site name and identification: Loamy Prairie 23-30 PZ (R078CY056OK)

Setting
Landscape: Uplands
Landform: Hillslopes on hills
Landform position (two-dimensional): Shoulder
Slope range: 3 to 5 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Low
Parent material: Loamy residuum weathered from calcareous sandstone
Restrictive feature(s): Paralithic bedrock at a depth of 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 9
Available water capacity: Low (about 4.7 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 3e

Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Sand bluestem, sideoats grama, switchgrass, little bluestem, Indiangrass, other perennial forbs and grasses, and shrubs

Typical Profile
A—0 to 12 inches; loam
Bw—12 to 24 inches; silt loam
Cr—24 to 40 inches; bedrock

Minor Components

Dill soils
Percent of map unit: 5 percent
Landform: Hillslopes on hills
Geomorphic position (two-dimensional): Backslope
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 3 to 5 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

Quinlan soils
Percent of map unit: 5 percent
Landform: Hillslopes on hills
Geomorphic position (two-dimensional): Backslope
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 3 to 5 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384785—Woodward loam, 1 to 3 percent slopes

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 1,000 to 2,495 feet
Mean annual precipitation: 20 to 32 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 185 to 230 days

Map Unit Composition

Woodward and similar soils: 95 percent
Dissimilar minor components: 5 percent

Description of the Woodward Soil

Classification
Soil taxonomic classification: Coarse-silty, mixed, superactive, thermic Typic Haplustepts
Ecological site name and identification: Loamy Prairie 23-30 PZ (R078CY056OK)

Setting
Landscape: Uplands
Landform: Hillslopes on hills
Landform position (two-dimensional): Shoulder
Slope range: 1 to 3 percent
Down-slope shape: Convex
Across-slope shape: Convex
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Low
Parent material: Loamy residuum weathered from calcareous sandstone
Restrictive feature(s): Paralithic bedrock at a depth of 20 to 40 inches
Frequency of flooding: None
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 9
Available water capacity: Low (about 4.7 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 3s
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Sand bluestem, sideoats grama, switchgrass, little bluestem, Indiangrass, other perennial forbs and grasses, and shrubs

Typical Profile
A—0 to 12 inches; loam
Bw—12 to 24 inches; silt loam
Cr—24 to 40 inches; bedrock

Minor Components

Carey soils
Percent of map unit: 5 percent
Landform: Hillslopes on hills
Geomorphic position (two-dimensional): Shoulder
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 1 to 3 percent
Down-slope shape: Convex
Across-slope shape: Convex
Meets hydric soil criteria: No

384792—Westola fine sandy loam, 0 to 1 percent slopes, occasionally flooded

Map Unit Setting

Major land resource area (MLRA): 78C—Central Rolling Red Plains, Eastern Part
Elevation: 695 to 2,250 feet
Mean annual precipitation: 20 to 32 inches
Mean annual air temperature: 57 to 65 degrees F
Frost-free period: 185 to 240 days

Map Unit Composition

Westola and similar soils: 90 percent
Dissimilar minor components: 10 percent

Description of the Westola Soil

Classification
Soil taxonomic classification: Coarse-loamy, mixed, superactive, calcareous, thermic Typic Ustifluvents
Ecological site name and identification: Loamy Bottomland 23-31” PZ (R078CY103TX)

Setting
Landscape: Valleys
Landform: Flood plains
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Negligible
Parent material: Calcareous loamy alluvium
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 6
Available water capacity: High (about 11.7 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 3e
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Big bluestem, Indiangrass, switchgrass, eastern gamagrass, Florida paspalum, little bluestem, other perennial grasses and forbs, shrubs, and trees

Typical Profile
A—0 to 10 inches; fine sandy loam
C1—10 to 40 inches; fine sandy loam
C2—40 to 80 inches; stratified loam to loamy fine sand

Minor Components

Lincoln soils
Percent of map unit: 8 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: No

Clairemont soils
Percent of map unit: 2 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: No

1605239—Canadian fine sandy loam, 0 to 1 percent slopes, rarely flooded

Map Unit Setting

Major land resource area (MLRA): 80A—Central Rolling Red Prairies
Elevation: 1,495 to 2,490 feet
Mean annual precipitation: 21 to 33 inches
Mean annual air temperature: 56 to 60 degrees F
Frost-free period: 190 to 210 days

Map Unit Composition

Canadian and similar soils: 85 percent
Dissimilar minor components: 15 percent

Description of the Canadian Soil

Classification
Soil taxonomic classification: Coarse-loamy, mixed, superactive, thermic Udic Haplustolls
Ecological site name and identification: Loamy Bottomland PE 44-64 (R080AY050OK)

Setting
Landscape: Valleys
Landform: Flood plains
Slope range: 0 to 1 percent

Down-slope shape: Linear
Across-slope shape: Linear
Representative aspect: Southeast
Aspect range: All aspects
Soil temperature class: Thermic
Soil temperature regime: Thermic
Soil moisture class: Ustic

Properties and Qualities
Runoff: Negligible
Parent material: Loamy alluvium
Restrictive feature(s): None within a depth of 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Depth to water table: More than 72 inches
Drainage class: Well drained
Shrink-swell potential: Low (about 1.5 LEP)
Salinity maximum: Not saline
Sodicity maximum: Not sodic
Calcium carbonate equivalent (maximum weight percentage): 0
Available water capacity: Moderate (about 8.3 inches)
Gypsum maximum: None

Interpretive Groups
Land capability subclass (nonirrigated areas): 1
Meets hydric soil criteria: No
Hydrologic soil group: B

Vegetation
Existing plants: Big bluestem, switchgrass, Indiangrass, eastern gamagrass, other perennial forbs and grasses, and shrubs

Typical Profile
A—0 to 15 inches; fine sandy loam
Bw—15 to 26 inches; fine sandy loam
C—26 to 60 inches; fine sandy loam

Minor Components

Port soils
Percent of map unit: 10 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: No

Westola soils
Percent of map unit: 5 percent
Landform: Flood plains
Representative aspect: Southeast
Aspect range: All aspects
Slope range: 0 to 1 percent
Down-slope shape: Linear
Across-slope shape: Linear
Meets hydric soil criteria: No

Use and Management of the Soils

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

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

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and forestland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and as 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.

Interpretive Ratings

The interpretive tables in this survey rate the soils in the survey area for various uses. Many of the tables identify the limitations that affect specified uses and indicate the severity of those limitations. The ratings in these tables are both verbal and numerical.

Rating Class Terms

Rating classes are expressed in the tables in terms that indicate the extent to which the soils are limited by all of the soil features that affect a specified use or in terms that indicate the suitability of the soils for the use. Thus, the tables may show limitation classes or suitability classes. Terms for the limitation classes are *not limited, somewhat limited,* and *very limited*. The suitability ratings are expressed as *well suited, moderately suited, poorly suited,* and *unsuited* or as *good, fair,* and *poor*.

Numerical Ratings

Numerical ratings in the tables indicate the relative severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use and the point at which the soil feature is not a limitation. The limitations appear in order from the most limiting to the least limiting. Thus, if more than one limitation is identified, the most severe limitation is listed first and the least severe one is listed last.

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 forestland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA-SCS, 1961).

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have slight limitations that restrict their use.

Class 2 soils have moderate limitations that restrict the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that restrict the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that restrict the choice of plants or that require very careful management, or both.

Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

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, 2e. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w, s,* or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, forestland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, 2e-4 and 3e-6. These units are not given in all soil surveys.

The capability classification of map units in this survey area is given in table 2 and in the section “Detailed Soil Map Units.”

Prime Farmland and Other Important Farmlands

Table 3 lists the map units in the survey area that are considered prime farmland, unique farmland, and farmland of statewide or local importance. This list does not constitute a recommendation for a particular land use.

In an effort to identify the extent and location of important farmlands, the Natural Resources Conservation Service, in cooperation with other interested Federal, State, and local government organizations, has inventoried land that can be used for the production of the Nation’s food supply.

Prime farmland 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 land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. The soil quality, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. The water supply is dependable and of adequate quality. Prime farmland is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. Slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

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

For some soils identified in the table as prime farmland, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures.

Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, and other fruits and vegetables. It has the special combination of soil quality, growing season, moisture supply, temperature, humidity, air drainage, elevation, and aspect needed for the soil to economically produce sustainable high yields of these crops when properly managed. The water supply is dependable and of adequate quality. Nearness to markets is an additional consideration. Unique farmland is not based on national criteria. It commonly is in areas where there is a special microclimate, such as the wine country in California.

In some areas, land that does not meet the criteria for prime or unique farmland is considered to be *farmland of statewide importance* for the production of food, feed, fiber, forage, and oilseed crops. The criteria for defining and delineating farmland of statewide importance are determined by the appropriate State agencies. Generally, this land includes areas of soils that nearly meet the requirements for prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some areas may produce as high a yield as prime farmland if conditions are favorable. Farmland of statewide importance may include tracts of land that have been designated for agriculture by State law.

In some areas that are not identified as having national or statewide importance, land is considered to be *farmland of local importance* for the production of food, feed, fiber, forage, and oilseed crops. This farmland is identified by the appropriate local agencies. Farmland of local importance may include tracts of land that have been designated for agriculture by local ordinance.

Hydric Soils

Table 4 lists the map unit components that are rated as hydric soils in the park. This list can help in planning land uses; however, onsite investigation is recommended to determine the hydric soils on a specific site (National Research Council, 1995; USDA-NRCS, 2010).

The three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology (Cowardin and others, 1979; U.S. Army Corps of Engineers, 1987; National Research Council, 1995; Tiner, 1985). Criteria for all of the characteristics must be met for areas to be identified as wetlands. Undrained hydric soils that have natural vegetation should support a dominant population of ecological wetland plant species. Hydric soils that have been converted to other uses should be capable of being restored to wetlands. Onsite investigation is recommended to determine the hydric soils on a specific site (National Research Council, 1995; USDA-NRCS, 2010).

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in “Soil Taxonomy” (Soil Survey Staff, 1999) and “Keys to Soil Taxonomy” (Soil Survey Staff, 2010) and in the “Soil Survey Manual” (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in “Field Indicators of Hydric Soils in the United States” (USDA-NRCS, 2010).

Hydric soils are identified by examining and describing the soil to a depth of about 20 inches. This depth may be greater if determination of an appropriate indicator so requires. It is always recommended that soils be excavated and described to the depth necessary for an understanding of the redoximorphic processes. Then, using the completed soil descriptions, soil scientists can compare the soil features required by each indicator and specify which indicators have been matched with the conditions observed in the soil. The soil can be identified as a hydric soil if at least one of the approved indicators is present.

Map units that are dominantly made up of hydric soils may have small areas, or inclusions, of nonhydric soils in the higher positions on the landform, and map units dominantly made up of nonhydric soils may have inclusions of hydric soils in the lower positions on the landform.

The criteria for hydric soils are represented by codes in the table (for example, 2B3). Definitions for the codes are as follows:

1. All Histels except for Folistels and Histosols except for Folists.
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that:
    - A. are somewhat poorly drained and have a water table at the surface (0.0 feet) during the growing season, or
    - B. are poorly drained or very poorly drained and have either:
        - 1) a water table at the surface (0.0 feet) during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
        - 2) a water table at a depth of 0.5 foot or less during the growing season if saturated hydraulic conductivity (K_{sat}) is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches, or
        - 3) a water table at a depth of 1.0 foot or less during the growing season if saturated hydraulic conductivity (K_{sat}) is less than 6.0 in/hr in any layer within a depth of 20 inches.
3. Soils that are frequently ponded for periods of long or very long duration during the growing season.
4. Soils that are frequently flooded for periods of long or very long duration during the growing season.

Landscape, Landform, Parent Material, and Ecological Site

Table 5 displays information about climate, landscape, landform, parent material, and ecological site for each soil in the map units.

Percent of the map unit is the extent of the named soil in the map unit.

Slope is the inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. The table shows the low and high range of slope for the named component or soil.

Elevation is the height of an object or area on the earth’s surface in reference to a fixed reference point, such as mean sea level. The typical low and high range of elevation is displayed for each soil.

MAP is the mean annual precipitation for areas of the soil in the map unit.

Landscape refers to the broad shape of the earth in the areas where the soil occurs. Examples are a valley and a moutain.

Landform is a specific shape of the earth in the area where a soil typically occurs. Examples are a mountain summit and a valley bottom.

Parent material is the material in which soils formed. Examples are the underlying geological material (including bedrock), a surficial deposit (such as volcanic ash), and organic material. Soils inherit their chemical and physical properties from the parent material.

Ecological site and number is the ecological site name and unique reference number that are correlated to the named soil in the map unit.

Ecological Sites

Plant communities are largely dependent on the soil, climate, topography, aspect, and slope of the landscape, as well as other abiotic features. To better understand these soil-plant interactions and the effects of selected management practices, the Natural Resources Conservation Service classifies forestlands and rangelands into ecological sites.

Landscapes of native vegetation are divided into ecological sites for the purposes of inventory, evaluation, and management. An ecological site, as defined for rangeland, is a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation.

An ecological site is the product of all the environmental factors responsible for its development, including parent material, landscape, climate, soils, living organisms, hydrology, fire, and time in place. Ecological site descriptions contain information on each of these environmental factors. Included are brief descriptions of: a) physiographic and climatic features; b) major identifiable plant community types that may occupy the site, including the reference plant community; c) total annual production; d) ecological dynamics of the plant communities; e) soils and their main properties; and f) site interpretations and general management considerations for wildlife, hydrology, recreation, fire, esthetics, and restoration or revegetation.

The reference plant community for a site has evolved under natural ecological processes and disturbances and is considered to be at the highest natural site potential under the current climate. It has developed on the site as a result of all site-forming factors and is best adapted to the unique combination of environmental factors associated with the site. Natural disturbances, such as fire, drought, herbivory, and flooding, were inherent in the development and maintenance of the reference plant community. Plant communities that have been subject to anthropogenic disturbances or physical site deterioration or have been protected from the natural disturbances do not typify the reference state and may exist in a stable or steady state that is different from the reference plant community.

The reference plant community of an ecological site is not a precise assemblage of species for which the proportions are the same from place to place or from year to year. In all plant communities, the productivity and occurrence of individual species vary. Special boundaries of the communities can be recognized by characteristic patterns of species composition, association, and community structure. Generally, one species or group of species dominates the site and the stability within the natural dynamics or disturbances of the site allows the species to be used as the factor that distinguishes one site from another.

At times, the extent of the less frequently occurring plants may increase on a site or plants not formerly occurring in the reference community may invade the site. The presence or abundance of these plants may fluctuate greatly because of the ability of the plants to adapt to the differences in the microenvironment, weather conditions, soil alterations, or human actions. Using these species for site identification can be misleading; thus they should not be used to differentiate sites.

The following ecological site inventory methods are used in determining the characteristic plant communities of an ecological site:

1. Identification and evaluation of reference and/or relict sites with similar plant communities and associated soils.
2. Interpolation and extrapolation of plant, soil, and climatic data from existing historic reference areas along a continuum to other points on that continuum for which no suitable reference community is available.
3. Evaluation and comparison of the same ecological site that occurs in different areas but that has experienced different levels of disturbance and management. Further comparison is made with areas that are not disturbed.

4. Evaluation and interpretation of research data dealing with the ecology, management, and soils in areas of the plant communities.

5. Review of historical accounts, survey and military records, and botanical literature of the areas.

The initial description of the reference state should be considered an approximation subject to modification as additional knowledge is gained or discovered.

Plant communities change along environmental gradients. When changes in soils, aspect, topography, or moisture conditions are abrupt, the plant community boundaries will be reasonably distinct. Boundaries are less distinct where the plant communities change gradually over wide environmental gradients of relatively uniform soils and topography. Thus, the need for site differentiation may not be readily apparent until the cumulative impact of soil, topography, hydrology, or climate is examined over a broad area. Frequently, such differences are reflected first in production and second in the kinds and proportions of a plant species making up the core of the plant community. In some cases, the boundaries that are drawn between ecological sites along a continuum of closely related soils and a gradually changing climate are somewhat arbitrary.

The following criteria are used to differentiate one ecological site from another:

1. Significant differences in the species or species groups that are in the characteristic plant community.

2. Significant differences in the relative proportion of species or species groups in the characteristic plant community.

3. Significant differences in the total annual production or site index of the characteristic plant community.

4. Soil factors that determine plant production and composition, the hydrology of the site, and the functioning of the ecological process of the water cycle, mineral cycles, and energy flow.

Differences in kind, proportion, and production of plants are the result of differences in soil, topography, climate, and other environmental factors. Slight variations in these factors are not criteria for site differentiation. Individual environmental factors are frequently associated with significant differences in reference plant communities. For differentiation into a distinct site to occur, the differences in the environmental factors must be great enough to affect the kinds, amounts, and proportions of the plant community.

Forestland is a spatially defined site where the reference community has at least 25 percent canopy cover. The reference community is the present-day climax community that most resembles the forest conditions prior to European contact. It developed with natural disturbances such as drought, fire, and insects. Several other plant communities may be present during the seral stages of development. Vegetation on forestland provides many habitat components, assists in controlling soil erosion, is suitable for grazing or browsing by wildlife, and offers scenic and recreational opportunities. Forestland is environmentally and economically important. For more information about NRCS national forestry policies, see the NRCS “National Forestry Manual,” which is available online at https://soils.usda.gov/technical/nfmanual/.

The reference community for a rangeland ecological site does not have the potential to produce at least 25 percent canopy cover. Several other plant communities may be present during phases of development or altered conditions. Vegetation on rangeland provides many habitat components, assists in controlling soil erosion, is suitable for grazing or browsing by wildlife and domestic animals, and offers scenic and recreational opportunities. Rangeland is environmentally and economically important.

Table 6 lists the map unit symbol and each map unit component’s name and percent of map unit alongside the ecological site name, ecological site type (forestland or rangeland), and ecological site number. Approved ecological site descriptions are available online at https://esis.sc.egov.usda.gov/. These descriptions are dynamic documents that are constantly updated as new research and data is gained; thus, the online version will be the most recent version of the descriptions.

Rangeland

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

Table 7 shows, for each soil that supports rangeland vegetation, the ecological site and the potential annual production of vegetation in favorable, normal, and unfavorable years. An explanation of the column headings in table 7 follows.

An *ecological site* is the product of all the environmental factors responsible for its development. It has characteristic soils that have developed over time throughout the soil formation process; a characteristic hydrology, particularly infiltration and runoff, that has developed over time; and a characteristic plant community (kind and amount of vegetation). The hydrology of a site is influenced by development of the soil and plant community. The vegetation, soils, and hydrology are all interrelated. Each is influenced by the others and influences the development of the others. The plant community on an ecological site is typified by an association of species that differs from that of other ecological sites in the kind and/or proportion of species or in total production. Descriptions of ecological sites are provided in the “Field Office Technical Guide,” which is available in local offices of the Natural Resources Conservation Service.

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

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 similarity index and rangeland trend. Range similarity index is determined by comparing the present plant community with the potential natural plant community on a particular rangeland ecological site. The more closely the existing community resembles the potential community, the higher the range similarity index. Rangeland trend is defined as the direction of change in an existing plant community relative to the potential natural plant community. Further information about the range similarity index and rangeland trend is available in chapter 4 of the “National Range and Pasture Handbook,” which is available in local offices of the Natural Resources Conservation Service.

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, an area with a range similarity index somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Land Management

In table 8, parts I through IV, interpretive ratings are given for various aspects of land management. The ratings are both verbal and numerical.

Some rating class terms indicate the degree to which the soils are suited to a specified land management practice. *Well suited* indicates that the soil has features that are favorable for the specified practice and has no limitations. Good performance can be expected, and little or no maintenance is needed. *Moderately suited* indicates that the soil has features that are moderately favorable for the specified practice. One or more soil properties are less than desirable, and fair performance can be expected. Some maintenance is needed. *Poorly suited* indicates that the soil has one or more properties that are unfavorable for the specified practice. Overcoming the unfavorable properties requires special design, extra maintenance, and costly alteration. *Unsuited* indicates that the expected performance of the soil is unacceptable for the specified practice or that extreme measures are needed to overcome the undesirable soil properties.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the specified land management practice (1.00) and the point at which the soil feature is not a limitation (0.00).

Rating class terms for *fire damage* and *seedling mortality* are expressed as low, moderate, and high. Where these terms are used, the numerical ratings indicate gradations between the point at which the potential for fire damage or seedling mortality is highest (1.00) and the point at which the potential is lowest (0.00).

Rating class terms for *hazard of erosion* are expressed as slight, moderate, severe, and very severe. Where these terms are used, the numerical ratings indicate gradations between the point at which the potential for erosion is highest (1.00) and the point at which the potential is lowest (0.00).

The paragraphs that follow indicate the soil properties considered in rating the soils for land management practices.

Planting

Ratings in the columns *suitability for hand planting* and *suitability for mechanical planting* are based on slope, depth to a restrictive layer, content of sand, plasticity index, rock fragments on or below the surface, depth to a water table, and ponding. The soils are described as well suited, moderately suited, poorly suited, or unsuited to these methods of planting. It is assumed that necessary site preparation is completed before seedlings are planted.

Ratings in the column *soil rutting hazard* are based on depth to a water table, rock fragments on or below the surface, the Unified classification, depth to a restrictive layer, and slope. Ruts form as a result of the operation of planting equipment. The hazard is described as slight, moderate, or severe. A rating of *slight* indicates that the soil is subject to little or no rutting, *moderate* indicates that rutting is likely, and *severe* indicates that ruts form readily.

Hazard of Erosion and Suitability for Roads

Ratings in the column *hazard of erosion* are based on slope and on soil erodibility factor K. The soil loss is caused by sheet or rill erosion in areas where 50 to 75 percent of the surface has been exposed by different kinds of disturbance. The hazard is described as slight, moderate, severe, or very severe. A rating of *slight* indicates that erosion is unlikely under ordinary climatic conditions; *moderate* indicates that some erosion is likely and that erosion-control measures may be needed; *severe* indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and *very severe* indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Ratings in the column *hazard of erosion on roads and trails* are based on the soil erodibility factor K, slope, and content of rock fragments. The ratings apply to unsurfaced roads and trails. The hazard is described as slight, moderate, or severe. A rating of *slight* indicates that little or no erosion is likely; *moderate* indicates that some erosion is likely, that the roads or trails may require occasional maintenance, and that simple erosion-control measures are needed; and *severe* indicates that significant erosion is expected, that the roads or trails require frequent maintenance, and that costly erosion-control measures are needed.

Ratings in the column *suitability for roads (natural surface)* are based on slope, rock fragments on the surface, plasticity index, content of sand, the Unified classification, depth to a water table, ponding, flooding, and the hazard of soil slippage. The ratings indicate the suitability for using the natural surface of the soil for roads. The soils are described as well suited, moderately suited, or poorly suited to this use.

Site Preparation

Ratings in the column *suitability for mechanical site preparation (deep)* are based on slope, depth to a restrictive layer, rock fragments on or below the surface, depth to a water table, and ponding. The soils are described as well suited, poorly suited, or unsuited to this management activity. The part of the soil from the surface to a depth of about 3 feet is considered in the ratings.

Ratings in the column *suitability for mechanical site preparation (surface)* are based on slope, depth to a restrictive layer, plasticity index, rock fragments on or below the surface, depth to a water table, and ponding. The soils are described as well suited, poorly suited, or unsuited to this management activity. The part of the soil from the surface to a depth of about 1 foot is considered in the ratings.

Site Restoration

Ratings in the column *potential for damage to soil by fire* are based on texture of the surface layer, content of rock fragments and organic matter in the surface layer, thickness of the surface layer, and slope. The soils are described as having a low, moderate, or high potential for this kind of damage. The ratings indicate an evaluation of the potential impact of prescribed fires or wildfires that are intense enough to remove the duff layer and consume organic matter in the surface layer.

Ratings in the column *potential for seedling mortality* are based on flooding, ponding, depth to a water table, content of lime, reaction, salinity, available water capacity, soil moisture regime, soil temperature regime, aspect, and slope. The soils are described as having a low, moderate, or high potential for seedling mortality.

Recreation

The soils of the park are rated in table 9, parts I and II, according to limitations that affect their suitability for recreation. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the recreational uses. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

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

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for building site development, construction materials, and water management.

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 ratings are based on the soil properties that affect the ease of developing camp areas and the performance of the areas after development. Slope, stoniness, and depth to bedrock or a cemented pan are the main concerns affecting the development of camp areas. The soil properties that affect the performance of the areas after development are those that influence trafficability and promote the growth of vegetation, especially in heavily used areas. For good trafficability, the surface of camp areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. The soil properties that influence trafficability are texture of the surface layer, depth to a water table, ponding, flooding, permeability, and large stones. The soil properties that affect the growth of plants are depth to bedrock or a cemented pan, permeability, and toxic substances in the soil.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The ratings are based on the soil properties that affect the ease of developing picnic areas and that influence trafficability and the growth of vegetation after development. Slope and stoniness are the main concerns affecting the development of picnic areas. For good trafficability, the surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. The soil properties that influence trafficability are texture of the surface layer, depth to a water table, ponding, flooding, permeability, and large stones. The soil properties that affect the growth of plants are depth to bedrock or a cemented pan, permeability, and toxic substances in the soil.

Foot traffic and equestrian trails for hiking and horseback riding should require little or no slope modification through cutting and filling. The ratings are based on the soil properties that affect trafficability and erodibility. These properties are stoniness, depth to a water table, ponding, flooding, slope, and texture of the surface layer.

Mountain bike and off-road vehicle trails require little or no site preparation. They are not covered with surfacing material or vegetation. Considerable compaction of the soil material is likely. The ratings are based on the soil properties that influence erodibility, trafficability, dustiness, and the ease of revegetation. These properties are stoniness, depth to a water table, ponding, slope, flooding, and texture of the surface layer.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the data in the tables described under the heading "Soil Properties."

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 between the surface and a depth of 5 to 7 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 should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about particle-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 7 feet of the surface, soil wetness, depth to a water table, ponding, 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 kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

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

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

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

Dwellings and Small Commercial Buildings

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. Table 10 shows the degree and kind of soil limitations that affect dwellings and small commercial buildings.

The ratings in the table are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Dwellings are single-family houses of three stories or less. For dwellings without basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet. The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Small commercial buildings are structures that are less than three stories high and do not have basements. The foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. The ratings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility (which is inferred from the Unified classification). The properties that affect the ease and amount of excavation include flooding, depth to a water table, ponding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Roads and Streets, Shallow Excavations, and Landscaping

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. Table 11 shows the degree and kind of soil limitations that affect local roads and streets, shallow excavations, and landscaping.

The ratings in the table are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

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 soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

Landscaping requires soils on which turf, trees, and shrubs can be established and maintained. Irrigation is not considered in the ratings. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer.

Sewage Disposal

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields and sewage lagoons. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

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 or between a depth of 24 inches and a restrictive layer is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Saturated hydraulic conductivity (K_{sat}), depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

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. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Considered in the ratings are slope, saturated hydraulic conductivity (K_{sat}), depth to a water table, ponding, depth to bedrock or a cemented pan, flooding, large stones, and content of organic matter.

Saturated hydraulic conductivity (K_{sat}) is a critical property affecting the suitability for sewage lagoons. Most porous soils eventually become sealed when they are used as sites for sewage lagoons. Until sealing occurs, however, the hazard of pollution is severe. Soils that have a K_{sat} rate of more than 14 micrometers per second are too porous for the proper functioning of sewage lagoons. In these soils, seepage of the effluent can result in contamination of the ground water. Ground-water contamination is also a hazard if fractured bedrock is within a depth of 40 inches, if the water table is high enough to raise the level of sewage in the lagoon, 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. If the lagoon is to be uniformly deep throughout, the slope must be gentle enough and the soil material must be thick enough over bedrock or a cemented pan to make land smoothing practical.

Source of Gravel and Sand

Table 13 gives information about the soils as potential sources of gravel and sand. Normal compaction, minor processing, and other standard construction practices are assumed.

Gravel and *sand* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. Only the likelihood 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 Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the bottom layer of the soil contains sand or gravel, the soil is considered a likely source regardless of thickness. The assumption is that the sand or gravel layer below the depth of observation exceeds the minimum thickness. The ratings are for the whole soil, from the surface to a depth of about 6 feet.

The soils are rated *good, fair,* or *poor* as potential sources of sand and gravel. A rating of *good* or *fair* means that the source material is likely to be in or below the soil. The bottom layer and the thickest layer of the soils are assigned numerical ratings. These ratings indicate the likelihood that the layer is a source of sand or gravel. The number 0.00 indicates that the layer is a poor source. The number 1.00 indicates that the layer is a good source. A number between 0.00 and 1.00 indicates the degree to which the layer is a likely source.

Source of Reclamation Material, Roadfill, and Topsoil

Table 14 gives information about the soils as potential sources of reclamation material, roadfill, and topsoil. Normal compaction, minor processing, and other standard construction practices are assumed.

The soils are rated *good, fair,* or *poor* as potential sources of reclamation material, roadfill, and topsoil. The features that limit the soils as sources of these materials are specified in the table. Numerical ratings between 0.00 and 0.99 are given after the specified features. These numbers indicate the degree to which the features limit the soils as sources of topsoil, reclamation material, or roadfill. The lower the number, the greater the limitation.

Reclamation material is used in areas that have been drastically disturbed by surface mining or similar activities. When these areas are reclaimed, layers of soil material or unconsolidated geological material, or both, are replaced in a vertical sequence. The reconstructed soil favors plant growth. The ratings in the table do not apply to quarries and other mined areas that require an offsite source of reconstruction material. The ratings are based on the soil properties that affect erosion and stability of the surface and the productive potential of the reconstructed soil. These properties include the content of sodium, salts, and calcium carbonate; reaction; available water capacity; erodibility; texture; content of rock fragments; and content of organic matter and other features that affect fertility.

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 whole soil, from the surface to a depth of about 5 feet. It is assumed that soil layers will be mixed when the soil material is excavated and spread.

The ratings are based on the amount of suitable material and on soil properties that affect the ease of excavation and the performance of the material after it is in place. The thickness of the suitable material is a major consideration. The ease of excavation is affected by large stones, depth to a 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 AASHTO classification of the soil) and linear extensibility (shrink-swell potential).

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. The ratings are based on the soil properties that affect plant growth; the ease of excavating, loading, and spreading the material; and reclamation of the borrow area. Toxic substances, soil reaction, and the properties that are inferred from soil texture, such as available water capacity and fertility, affect plant growth. The ease of excavating, loading, and spreading is affected by rock fragments, slope, depth to a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, depth to a water table, rock fragments, depth to bedrock or a cemented pan, and toxic material.

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.

Ponds and Embankments

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

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 saturated hydraulic conductivity (K_{sat}) 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. Embankments that have zoned construction (core and shell) are not considered. 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 5 or 6 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.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, K_{sat} of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey.

Soil properties are ascertained 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 particle-size distribution, plasticity, and compaction characteristics.

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

The estimates of soil properties are shown in tables. They include engineering properties, physical and chemical properties, and pertinent soil and water features.

Engineering Properties

Table 16 gives the engineering classifications and the range of engineering properties for the layers of each soil in the park.

Depth to the upper and lower boundaries of each layer is indicated.

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 15 percent or more, an appropriate modifier is added, for example, “gravelly.”

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-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 particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

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

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

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

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

Physical Soil Properties

Table 17 shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the park. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (K_{sat}), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^{1}/_{3}$- or $^{1}/_{10}$-bar (33-kPa or 10-kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability (K_{sat}) refers to the ability of a soil to transmit water or air. The term "permeability," as used in soil surveys, indicates saturated hydraulic conductivity (K_{sat}). The estimates in the table indicate the rate of water movement, in inches per hour, 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 and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. 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.

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 the basis of 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 classes are *low,* a change of less than 3 percent; *moderate,* 3 to 6 percent; *high,* 6 to 9 percent; and *very high,* greater than 9 percent.

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

The content of organic matter in a soil can be maintained by returning crop residue to the soil. Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion Properties

Table 18 shows estimates of some erosion factors that affect a soil's potential for different uses. These estimates are given for each layer of every soil for K factors and are given as one rating for the entire soil for the T factor, the wind erodibility group, and the wind erodibility index. Values are reported for each soil in the park. Estimates are based on field observations and on test data for these and similar soils.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Soil erosion factors (Kw) and (Kf) quantify soil detachment by runoff and raindrop impact. These erosion factors are indexes used to predict the long-term average soil loss from sheet and rill erosion under crop systems and conservation techniques. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) 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 and on soil structure and K_{sat}.

Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

The procedure for determining the Kf factor is outlined in Agriculture Handbook 703, “Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE),” USDA, Agricultural Research Service, 1997.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments. In horizons where total rock fragments are 15 percent or more, by volume, the Kw factor is always less than the Kf factor.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size. Soil horizons that do not have rock fragments are assigned equal Kw and Kf factors.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/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 susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the “National Soil Survey Handbook.”

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Soil Features

Table 19 gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness of the restrictive layer, which significantly affects the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Potential for 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, saturated hydraulic conductivity (K_{sat}), 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 to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes 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 results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete 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 also is expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Water Features

Table 20 gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, 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 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 a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

The *months* in the table indicate the portion of the year in which a water table, ponding, and/or flooding is most likely to be a concern.

Water table refers to a saturated zone in the soil. Table 20 indicates, by month, depth to the top (*upper limit*) and base (*lower limit*) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. The table indicates *surface water depth* and the *duration* and *frequency* of ponding. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. *None* means that ponding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

Flooding is the temporary inundation of an area 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, and water standing in swamps and marshes is considered ponding rather than flooding.

Duration and *frequency* are estimated. Duration is expressed as *extremely brief* if 0.1 hour to 4 hours, *very brief* if 4 hours to 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. *None* means that flooding is not probable; *very rare* that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); *frequent* that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year); and *very frequent* that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

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

Total Soil Carbon

Table 21 gives estimates of total soil carbon. Soil carbon occurs as organic and inorganic carbon.

Soil organic carbon (SOC) is carbon (C) in soil that originated from a biological source, such as plants, animals, or micro-organisms. SOC is found in both organic and mineral soil layers. The term “soil organic carbon” refers only to the carbon occurring in soil organic matter (SOM). Soil organic carbon makes up about one-half the weight of soil organic matter. The rest of SOM is mostly oxygen, nitrogen, and hydrogen.

Soil inorganic carbon (SIC) is carbon found in soil carbonates, typically as calcium carbonate layers in the soil or as clay-sized fractions throughout the soil. Carbonates in soils are most common in areas where evaporation rates exceed precipitation, as is the case in most desert environments. Typically, the carbonates accumulated from carbonatic dust or from solution during periods of wetter climates. Soil inorganic carbon also occurs in soils that formed in marl in all regions of the country.

The SOC and SIC contents are reported in kilograms per square meter to a depth of 2 meters or to a representative depth of either hard bedrock or a cemented horizon. The SOC and SIC values are on a whole soil basis, corrected for rock fragments.

SOC can be an indicator of overall soil fertility and soil quality that affects ecosystem function. SOM is the main reservoir for most plant nutrients, such as phosphorus and nitrogen. Managing for SOC by managing for SOM increases the content of these elements and improves soil resiliency.

Soil organic matter binds soil particles together and thus increases soil porosity and water infiltration and allows better root penetration and waterflow into the soil. Greater inflow of water reduces the hazard of erosion and the rate of surface water runoff.

Greater SOC levels improve not only soil quality but also the quality of air and water. Soil acts as a filter and improves water quality. Fertile soils that support plant life remove CO_2 from the atmosphere and increase oxygen levels through photosynthesis. Maintaining the level of soil organic carbon reduces C release into the atmosphere and thus can lessen the effects of global warming.

SIC influences the types of plants that will grow. High SIC levels are commonly associated with a higher soil pH, which limits the types of plants that will thrive.

Like SOM, soil carbonates, the source of SIC, also bind soil particles together. They fill voids in the soil and thus can reduce soil porosity. Compacted soil carbonates may restrict root penetration and waterflow into the soil.

Chemical Soil Properties

Table 22 shows estimates of some chemical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the park. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Cation-exchange capacity is the total amount of extractable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

Soil reaction is a measure of acidity or alkalinity. The pH of each soil 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.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization.

Gypsum is expressed as a percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Gypsum is partially soluble in water. Soils that have a high content of gypsum may collapse if the gypsum is removed by percolating water.

Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced saturated hydraulic conductivity (K_{sat}) and aeration, and a general degradation of soil structure.

Formation and Classification of the Soils

This section relates the soils in Washita Battlefield National Historic Site to the major factors of soil formation and describes the system of soil classification.

Factors of Soil Formation

By Susan Burlew Southard, Natural Resources Conservation Service.

Soil covers the surface of the earth as a three-dimensional body of varying thickness and is made up of different proportions of organic and mineral material and pore space filled with gases and water. Soils differ in their appearance, productivity, and management requirements due to their chemical and physical properties. The characteristics and properties of soils are determined by physical and chemical processes that result from the interaction of five soil-forming factors. These factors of soil formation are interdependent, and few generalizations can be made regarding any one factor unless the effects of the other factors are known. The term “pedogenesis” is often used to connote the processes of soil formation.

The interacting soil-forming factors are parent material, climate, organisms, time, and relief or topography. *Parent material* is the source material in which soils formed. Soils are influenced by the texture and structure of the parent material and its mineralogical and chemical composition. *Climate* is predominantly the temperature and kind and amount of precipitation. Climate is also the seasonal distribution of temperature and precipitation. *Organisms* are the plants and other organisms living in and on the soil, including humans. *Time* refers to how long the soil-forming factors have been operating on a particular landscape. *Relief* or *topography* is the shape and elevation of the landscape. It affects internal and external soil properties, such as soil drainage, aeration, susceptibility to erosion, and the soil’s exposure to the sun and wind (Jenny, 1941).

The processes of soil formation are sequences of events, involving biogeochemical reactions that are energized by climate and spatially related to relief or topography (Buol et al., 2011). The physical and chemical properties of a soil are altered by these reactions over time. The influence of any one of these factors varies among all parks and within localities of a particular park. Soils may differ significantly from place to place in a park and within very short distances as a result of complex interaction among the five factors. On the other hand, parks may have vast stretches of the same type of soil because of uniform soil-forming factors. The processes of soil formation in Washita Battlefield National Historic Site, Oklahoma, are similar to those at Fort Laramie National Historic Site, Wyoming.

Setting of Washita Battlefield National Historic Site (Washita Battlefield NHS)

Understanding the setting and geology of the park helps in understanding the parent materials contributing to the types of soils it contains. Soil-forming processes are influenced by rock type, topographic expression, and hydrologic properties of the area. These processes influence soil properties and behavior, which help to determine best management practices.

Figure 1.—The Cloud Chief Formation is exposed in an unnamed knoll along the trail to the Washita River. The red parent material gives the soils in the area their red color. (Photo by Katie KellerLynn)

Washita Battlefield NHS is located in western Oklahoma in a land resource region called the Central Rolling Red Plains. The area is characterized by smooth to rolling hills and valleys with stair-step stream terraces. The hills are moderately dissected. Some badland areas lie below some of the steeper prominent ridges. The geologic formations in the park include the Cloud Chief Formation, which makes up the oldest rocks that are exposed (fig. 1). The Cloud Chief Formation was deposited in a shallow ocean setting, probably under arid conditions at the edge of an inland sea. This formation is variably referred to as “red clay,” “red claystone,” or “red shale.” These Permian-age red sedimentary rocks contribute to the red color of the soils. Some areas of the Cloud Chief Formation in the park have thin lenses of gypsum.

The knolls and bluffs surrounding the park are made up of the Doxey Formation. This formation was deposited on a coastal mudflat, tens of feet above sea level (KellerLynn, 2011). It is more resistant than the Cloud Chief Formation but still prone to erosion and forms the badlands. Close to the river are fluvial terraces and stream deposits of the Quaternary Period. Fluvial deposits include fine grained sediments. Quaternary dune sand also occurs in the survey area (KellerLynn, 2011).

The park is within the watershed of the Red River. The Washita River is a tributary of the Red River, which is one of two major drainage basins within Oklahoma. The other major drainage basin in Oklahoma is the Arkansas River. The Washita River headwaters are in the northeastern part of the Texas Panhandle. This river flows southeast towards the Red River, which forms the Oklahoma-Texas border. The Washita River flows approximately 50 miles (80 kilometers) from its source in Texas before entering Washita Battlefield NHS.

The park overlooks the Washita River valley. Various geomorphic landforms dominate the park's landscape. Stream terraces line the valley. The flat-topped terraces, directly above the Washita River, were good campgrounds for the warriors and their families at the time of the Washita Battle (KellerLynn, 2011). The geomorphic settings and major soil-forming factors in Washita Battlefield NHS are similar to those in Fort Laramie National Historic Site in Wyoming, Sand Creek Massacre National Historic Site in Colorado, and Little Bighorn Battlefield National Monument in Montana.

The rolling red plains of the park have been slowly uplifting for the past 5 million years. The regional uplift was due to the mountain building and subsequent erosion of the Rocky Mountains to the west, which resulted in a rebound affect (the area rose in elevation) to the east in the high plains. As the plains rose in elevation, rivers cut through them. New source materials for soil formation were created as rivers and streams meandered across the landscape. These rivers and streams carried eroded sediments that cut and eroded local geologic formations. The rivers then deposited new unconsolidated sediments known as alluvium. The landscape is a result of erosional processes, mainly the downcutting and redeposition by rivers. An array of different soils formed on the erosional deposits.

The Red and Washita Rivers meander back and forth across the landscape creating abandoned stream channels called oxbows. The increasing sinuosity of the channel as it meanders downstream is a result of changes in the local gradient, sediment particle size of the flood-plain deposits, and the conditions of riparian vegetation. The sediment particle size and organic matter accumulation from decaying vegetation influence the soils that form from them.

Parent Material

Parent material is the unconsolidated mass in which soils form. The parent material of mineral soils is a product of weathering of underlying bedrock in place or weathering of material that has been transported. Organic soils form in place from the accumulation and decomposition of plant material, such as wood, leaves, and aquatic plants. Weathering refers to the chemical and physical disintegration and decomposition of parent material. Few soils weather directly from the underlying rocks. More commonly, soils form in materials that have moved in from elsewhere. Soils generally have a dominant kind of parent material but are influenced by other types of parent material. Material may have been moved only a few feet by gravity (colluvial parent material) or transported long distances by wind (eolian parent material) or by water (alluvial parent material). Soils have residual parent material if they formed directly from underlying rocks or from an *in situ* plant source. Soils that formed in residuum may have the same general chemistry as the original rocks, depending on the degree of weathering that has occurred.

The soils of Washita Battlefield NHS formed predominantly from 1) alluvium, 2) a combination of residuum and colluvium, or 3) a combination of eolian and alluvial materials.

Alluvium

Alluvial parent material can have different textures, depending on whether the water moves quickly or slowly. The type of rocks occurring in the source region of the streams and rivers also determines characteristics of the alluvium. Fast-moving water deposits gravel, rocks, and sand. Slow-moving water leaves fine textured deposits (clay and silt) when sediments in the water settle out. Most of the alluvium from which soils have formed in Washita Battlefield NHS is sandy or loamy and was derived from the sedimentary rocks of the Cloud Chief and Doxey Formations. Examples of alluvial soils in the park are Lincoln (which formed from calcareous alluvium), Clairemont (which formed from calcareous silty alluvium), Port and Westola (which formed from calcareous loamy alluvium), and Canadian (which formed from loamy alluvium). All of these soils are associated with the flood-plain and river terraces of the Washita River. Lincoln soils are mapped on Holocene alluvial deposits in the lowest positions on the river terraces, only a few feet above the river. These soils are along the meanders of the river. These positions flood frequently (see table 20). In the higher terrace positions are Clairemont soils (which are occasionally flooded) and, above them, Canadian soils (which are rarely flooded).

Due to its calcareous parent material, Westola soils have more soil inorganic carbon (SIC) sequestered in their horizons than any other soils in the park (see table 21). Soil inorganic carbon (SIC) is carbon found in soil carbonates, usually as calcium carbonate layers in the soil or as clay-sized fractions throughout the soil. Carbonates in soils are found in areas where evaporation rates exceed precipitation, as is the case in most desert environments. Usually the carbonates accumulated from carbonatic dust or from solution when wetter climates existed. Carbonate C is measured by treating the soil with HCl then measuring the evolved CO_2 with a manometer. Based on soil survey data, the soil carbon in Westola soils is mostly in the inorganic form as calcium carbonate and makes up 21 kg/m^2 (or 93 tons/acre), which exceeds the organic form content by four times.

Grandfield soils are mapped on a paleoterrace above the river along Highway 47 in the southwestern corner of the park. They are also mapped in the southeastern part of the park near the overlook and the southern extent of the trailhead. A paleoterrace is formed by the downcutting of an old, abandoned flood plain. The paleoterraces in Washita Battlefield NHS are the highest positions on the landscape. These paleoterraces were covered by loess that was blown out of the ancestral interior seaway, which had drained and exposed the sedimentary rocks to weathering. Pleistocene-age to present-day loess contributions are probably dominantly from the Washita River valley (figs. 2 and 3).

Grandfield soils are very deep, well drained soils. These soils have a mantle of eolian sands that have blown out of the river bottoms. They are relatively well developed soils with layers of clay accumulation (an argillic horizon). River downcutting, which developed the abandoned flood plain, has been an ongoing process for hundreds of thousands of years. The end of active fluvial processes provided landscape stability, thus allowing soil features, such as argillic horizons, to develop over time.

Eolian Parent Material

Loess is eolian parent material that has been blown for long distances. It consists mainly of silt-sized particles. Other eolian parent materials may be sandy. Eolian parent material is common in parks of the Midwest. For thousands of years to present-day, the Central Plains have had a prevalent northwesterly wind pattern. Soils that formed in alluvium and/or loess in the park are Grandfield, Nobscot, Eda, and Devol. These soils occur on dunes on sand sheets or sandhills (see table 5). Some sand sheets may be relicts of the Dust Bowl of the 1930s, when the native prairie was plowed and planted to wheat.

Residuum and Colluvium

Soils that formed from residuum and colluvium include Quinlan and Woodward. Woodward soils are amoung the dominant soils in the park. These soils occur on

Figure 2.—This area of the park is mapped Grandfield-Nobscot complex, 5 to 8 percent slopes, and includes an inverted collapse feature. Collapse features form from the dissolution of salts in underlying Permian red beds. Erosion removes the soil surrounding the collapse feature, leaving a mound. (Photo by Katie KellerLynn)

Figure 3.—The park headquarters for Washita Battlefield National Historic Site is situated on a paleoterrace mapped Grandfield-Nobscot complex, 5 to 8 percent slopes. Grandfield soil has a yellowish red zone of clay accumulation at a depth of about 18 inches. Nobscot soil is similar but has a thick sandy surface layer.

hillslopes and summits. They are mapped south of the Washita River on very gently sloping to moderately steep ridge crests and side slopes of ridges and escarpments. The soils are derived from calcareous sandstone. Quinlan soils formed in residuum and colluvium derived from calcareous sandstone. These soils are shallow and well drained. They formed in loamy residuum weathered from noncemented, calcareous red sandstone of Permian age. They have a red, noncemented bedrock contact at a depth of 10 to 20 inches (see table 19).

Soil parent material is commonly a major factor in the development of ecological niches in a park. The influence of parent material on soil depth and soil chemistry dictates the types of vegetation that can grow in specific areas. For example, Woodward soils are correlated to the Loamy Prairie 23-30 PZ ecological site. Ecological sites support certain plant communities. The presumed historic plant community (HPC) for the Loamy Prairie 23-30 PZ ecological site is a mixture of dominantly tall grasses with smaller components of mid grasses and short grasses. Various plant community percentages can manifest themselves on this site, depending on the site's location within the region (i.e., plant communities differ according to differences in precipitation and temperature) or depending on the site's location on the landscape (i.e., plant communities differ according to the steepness and/or exposure of slopes). Because Loamy Prairie sites are productive, a large percentage of these sites were, and still are, cultivated.

Climate

Differences in climate can result in differences in soils. Temperature and moisture influence soil formation and are the two most commonly measured features of climate. Weathering is most active when soils are moist and warm because these soil conditions are conducive to rapid chemical reactions and increased biological activity in the soil. Cooler temperatures result in slower chemical reactions. While average temperatures and precipitation are important in determining soil properties, the extremes of climate in any given locale also play a major role in soil formation.

Wind redistributes sand, salts, carbonates, and other particles in parks in arid and semiarid regions. The soils of the Washita Battlefield NHS formed, and are still forming, in a dry climate with limited precipitation. Some of the soils, such as Clairemont, are calcareous to the surface because there is not enough rainfall to leach the carbonates from the soil and because present-day winds constantly add more carbonates to the soil. During periods of rainfall or snowmelt, water carrying dissolved or suspended solids moves through soil in a process called leaching. Leaching becomes active with the onset of rainfall or snowmelt. Because of the park's arid climate, leaching processes are limited in the park soils.

Present-day climate variations are the result of topography and relief. In most areas of the United States, temperature generally decreases with elevation and precipitation generally increases with elevation. As the amount of precipitation increases, the extent of leaching and the amount of vegetation generally increase to a point where they then decrease because of decreasing temperatures. Fluctuations in temperature and moisture affect the rate of organic matter production, decomposition, and accumulation and the weathering of minerals. Due to its small size and low relief, the overall climatic regime of the park is fairly uniform.

In general, most of the southern part of the Great Plains encompassing Washita Battlefield NHS averages 25 inches of precipitation annually. Snowfall is generally not significant. Heavy snowfall occurs infrequently, usually in late winter or early spring. The sun shines 70 to 80 percent of the time in summer. Occasional rain showers and thunderstorms occur mostly during the afternoons. Spring is typically the windiest time of the year, when winds average more than 20 miles per hour about 15 percent of the time. Winds with speeds of 50 miles per hour or stronger occasionally occur in summer when a weather system accompanying a thunderstorm crosses the State. The growing season (number of freeze-free days) averages about 100 to 125 days. Temperatures are extreme, ranging from an average low of about 45 degrees F below zero to an average high of nearly 110 degrees F. Temperatures can reach 90 degrees F or more any month between May and September. Winters are cold with several days of below zero temperatures each year.

Soils on stable landforms, such as Nobscot soils on paleoterraces, have been affected by climatic conditions different from those of today (a paleoclimate). The Nobscot series consists of very deep, well drained, moderately rapidly permeable soils that formed in wind-modified loamy and sandy sediments of Pleistocene age. Native vegetation consists of shinnery oak with an understory of tall grasses. These paleosols formed on a landscape in a past climate. They have distinct morphological features, such as an argillic horizon, resulting from a soil-forming environment that no longer exists on the site. The distribution of silts in the soil suggests that the soil was influenced by strong directional winds that deposited larger amounts of silt than would be deposited today.

Organisms

Plants, animals, micro-organisms, and humans affect the formation and shape of soils. Plants capture solar energy via photosynthesis and transfer that energy to the soil. This energy is a fundamental driver of many soil processes. Fungi and bacteria are the primary organisms that decompose organic matter and add nutrients to the soil. Animals and micro-organisms mix soils and form burrows and pores. Plant roots open channels in the soils. Abandoned animal burrows commonly are filled with loose material from the overlying horizons and transmit water more readily than the surrounding undisturbed soil material.

Different types of roots have different effects on soils. Grass roots are fibrous and decompose easily, adding organic matter to the soil. Fine grass roots can extend below the surface for many feet. Plant roots also help to develop soil structure and aggregate stability. Vegetation increases soil stability by protecting the surface against wind and water erosion. Taproots open pathways through dense layers. Micro-organisms affect chemical exchanges between roots and soil. Humans also can mix the soil extensively.

Port, Clairemont, and Canadian soils formed in loamy alluvium and have a dark surface color due to organic matter accumulation. They are in flood-plain positions. For these soils, organic matter has accumulated from a plant community that had higher productivity due to water concentration from the surrounding areas. Clairemont soils have the highest content of soil organic carbon (SOC) in the park (see table 21). These soils have 17 kg/m^2 of SOC, which equates to 75 tons of SOC per acre. Soil organic carbon makes up about one-half the weight of soil organic matter. Soil organic carbon is carbon (C) in soil that originated from a biological source, such as plants, animals, or micro-organisms. SOC refers only to the carbon occurring in soil organic matter.

SOC is found in organic and mineral layers of the soil. Layers in soil are referred to as “horizons” by soil scientists. Soil horizons are named “O,” “A,” “B,” or “C.” O horizons have high levels of organic carbon and very little mineral content, and C horizons typcially have the least amount of soil organic carbon and a high mineral content.

Root growth and humification of organic matter can darken soils to considerable depth. Humification occurs when micro-organisms decompose leaves, wood, roots, and animals and convert them to humic substances. Humic substances are broadly defined products of organic matter decomposition that are relatively resistant to further microbial decomposition. Humic substances with a high content of carbon can remain in the soil for a long time, e.g., hundreds to thousands of years. Some examples of humic substances are humic and fulvic acids and humins. Humification is common in prairies where there is prolific root growth of native grasses. Native grasses contributed to the organic matter content of the soils in upland positions in the park.

The native vegetation, which helps to determine SOC levels, depends on climate, topography, and biological factors plus many soil factors, such as soil density, depth, chemistry, temperature, and moisture. Leaves from plants fall to the surface and decompose on the soil. Organisms decompose these leaves and mix them with the upper part of the soil. This results in the cycling of nutrients and energy back to vegetation.

Humans also affected the level of SOC in the soils. Plowing up native grasses during the Dust Bowl of the 1930s resulted in loss of surface soil and decreased carbon levels and caused tremendous dust storms. Areas of sand sheets near the survey area may be relicts of the Dust Bowl. As the area was homesteaded and population increased, the trees along the Washita River were cut and used for timber, the soil was tilled, fences were erected, and terraces were cut into slopes (to slow runoff during the 1930s) (USDI-NPS, 2001).

Time

Time for parent material, climate, organisms, and topography to interact with the soil is also a soil-forming factor. Over time, soils exhibit features that reflect the interaction of other soil-forming factors. Recently deposited material, such as material deposited by a flood, exhibits no features from soil development activities and its properties are mostly inherited from the new material. The previous soil surface and underlying horizons become buried. The time clock resets for these soils. The different horizons in a soil profile and the degree of development can be directly related to time. Because terraces above the active flood plain, while similar in origin to the flood plain, are older land surfaces of old abandoned flood plains, soils on terraces exhibit more horizon development. Washita Battlefield NHS has this situation.

Soils such as Lincoln and Westola have few distinctive characteristics and no diagnostic subsurface horizons. These soils are on the youngest geomorphic surfaces, generally on flood plains associated with the Washita River, where alluvium has been deposited. Because they are on recent deposits of the river bottom, they have not existed long enough to develop soil horizons. Most soils along the Washita River show a minimal degree of pedogenesis (lack horizonation) due to the dynamic, changing landscape.

Soils on stream terraces, such as Devol, are more stabilized and have greater profile development. Terraces are former flood plains and mark the positions of earlier streams. The youngest terrace level in the park is 8 to 10 feet above the riverbed.

Topography and Relief

Topography refers to the shape of the landscape, and relief refers to differences in elevation. The overall landscape in a park, whether it consists of flat flood plains, rolling hills, or dissected terraces, is the result of erosion and depositional processes. These processes may have occurred in response to changes in climate, fluctuating sea levels, and/or tectonic activities. Cyclic periods of landscape stability and instability influence the types of soils that form on the landscape.

Slope and aspect of the overall landscape can affect the moisture and temperature of the soil. Steep slopes that face the sun are warmer. Soils on steep slopes may erode and lose their surface horizons as they form. Thus, these soils may be thinner than the more nearly level ones that receive deposits from areas upslope. Deeper, darker soils occur on the bottom land (fig. 4). Soil-forming factors continue to affect soils even on stable landscapes. Materials are deposited on their surface, and materials are blown or washed away from the surface. Additions, removals, and

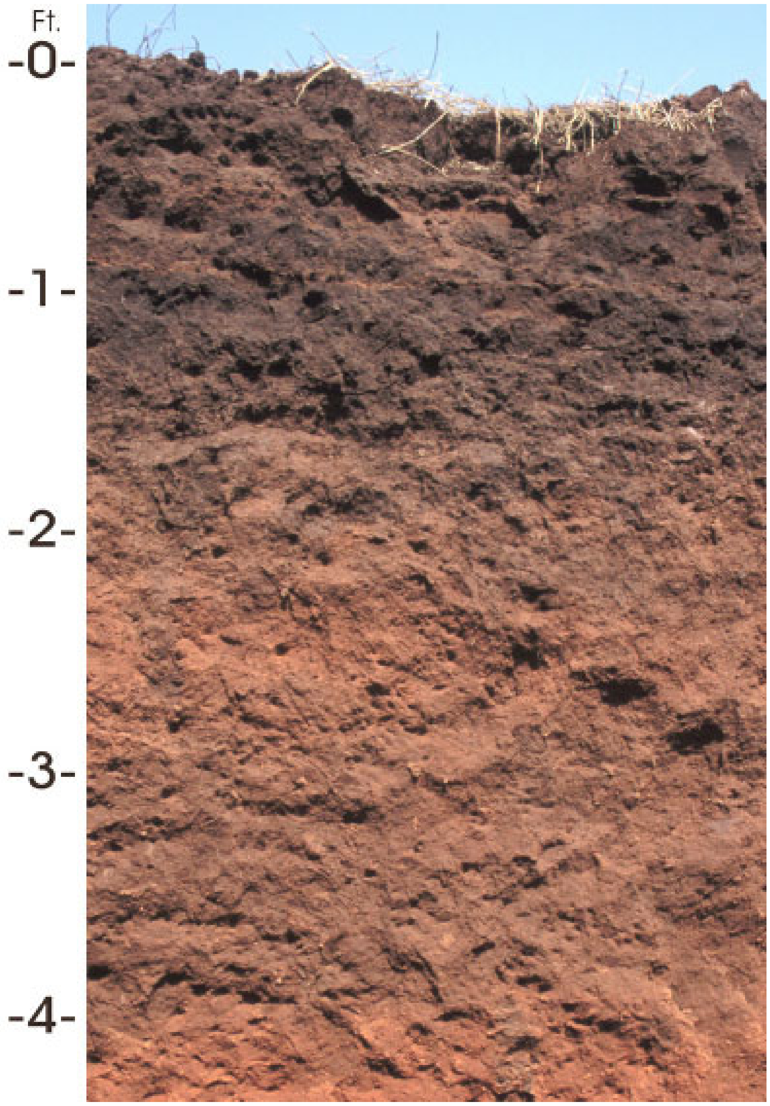


Figure 4.—Port silt loam is mapped along the flood plain of the Washita River in the southwestern area of the park, along Highway 47. Port is a very deep, well drained soil that formed in recently deposited calcareous loamy alluvium. Native vegetation is tall grasses with an overstory of pecan, black walnut, bur oak, and eastern cottonwood trees.

alterations are slow or rapid and dependent on climate, landscape position, and biological activity.

Relief influences soil formation mainly through its effect on runoff and erosion. It also influences soil temperature, plant cover, depth to the water table, and the accumulation and removal of organic matter. Because it causes differences in external soil drainage, relief can differentiate soils that formed in the same kind of parent material (fig. 5). Water that runs off the more sloping soils can collect in depressions or drainageways. Grandfield soils on nearly level paleoterraces are very deep and well drained. Nearly level Clairemont soils on alluvial flats and terraces have accumulations of sodium, carbonates, and gypsum in the lower part of their profile.

Most of the soils of Washita Battlefield NHS are affected by slope instability and high erosion rates, especially where left unvegetated. The geologic units underlying

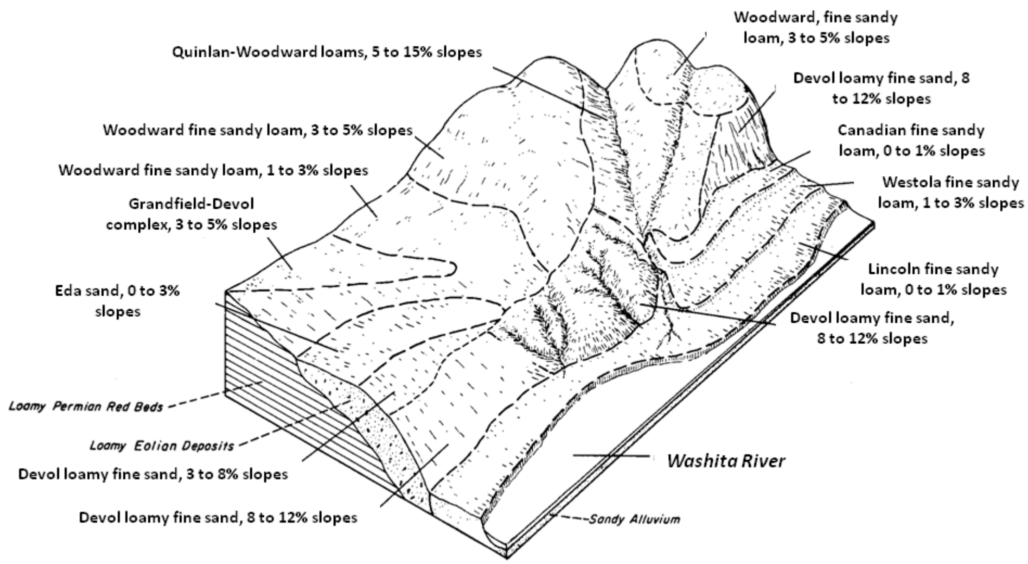


Figure 5.—A stylized and generalized block diagram showing the expected relationships of soils to landscape position and parent material in the general area of the park. Relief in the diagram appears greater than what actually occurs within the park.

the slopes of the park contain a heterogeneous mix of siltstone and sandstone. Silt-rich units may disaggregate when they become saturated with water and are prone to fail when exposed on a slope.

Ezell soil, which is a minor component in a flood-plain map unit, has a water table close enough to the surface and floods frequently enough in its natural state to be classified as hydric (see table 4). Because the hydrologic function of the survey area is controlled by a series of dams, flooding on the Washita River is not a serious issue for the infrastructure of the park. Under present conditions, the river channel is sometimes dry. In the past, both before and after the 1868 battle, flooding of the Washita River across the entire flood plain had been a natural and regular process (fig. 6).

Seasonal and periodic large-scale flooding events ended in the 1950s when flood-control structures were placed on the Washita River and many of its tributaries. Flooding still occurs occasionally within the park but only when check dams upriver fail, such as during wet spring periods (KellerLynn, 2011).

Relief and topography also influence the designation of prime farmland map units. Because of landscape position, flood plains with very deep soils and with no root restrictions are often rated as prime farmland (see table 3). Topography, relief, and landscape position are important factors in determining soil properties in the park.

Classification of the Soils

Soils are named and classified on the basis of physical and chemical properties in their horizons (layers). Color, texture, structure, and other properties of the soil to a depth of 2 meters are used to key the soil into a classification system. This system helps people to use soil information and also provides a common language for scientists.

Soils and their horizons differ from one another, depending on how and when they formed. Soil scientists use the five soil-forming factors to help predict where different soils may occur. The degree and expression of the soil horizons reflect the extent of interaction of the soil-forming factors with one or more of the soil-forming processes (Simonson, 1959).

Figure 6.—Lincoln soils occur immediately adjacent to the river bottom, below the lowest-level river terrace, on nearly level to undulating flood plains that may flood frequently. These soils formed in sandy fluvial sediments. Native vegetation is tall grasses with some eastern cottonwood and tamarisk. Black Kettle's Camp was located slightly above the Lincoln soils, on a terrace mapped as Westola soils. Westola soils flood occasionally and are mapped predominantly on the south side of the river. From its headwaters in the Texas Panhandle, the Washita River (shown in the image) meanders across the entire length of the national historic site. (Photo by Katie KellerLynn)

When mapping soils, a soil scientist looks for areas with similar soil-forming factors to find similar soils. The properties of the soils are described. Soils with the same kind of properties are given taxonomic names. Soils are classified, mapped, and interpreted on the basis of various kinds of soil horizons and their arrangement. The distribution of soil orders corresponds with the general patterns of the soil-forming factors within the park.

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1999 and 2010). 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. The categories are defined in the following paragraphs.

ORDER. Soil taxonomy at the highest hierarchical level identifies 12 soil orders. The names for the orders and taxonomic soil properties relate to Greek, Latin, or other root words that reveal something about the soil. 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. Sixty-four suborders are recognized at the next level of classification. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust* meaning burnt, which implies the ustic moisture regime, 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; type of saturation; and base status. There are about 300 great groups. 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 Haplustoll (*Hapl,* meaning simple or minimal horizon development, plus *Ustoll,* the suborder of the Mollisols that has an ustic moisture regime).

SUBGROUP. There are more than 2,400 subgroups. Each great group has a typic subgroup. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Other subgroups are intergrades or extragrades. 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 taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Cumulic* identifies the subgroup that has an epipedon or surface horizon that is thicker and has more organic matter than is typical. An example is Cumulic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties for family placement are those of horizons below a traditional agronomic plow depth. Among the properties and characteristics considered are particle-size class, mineralogy class, cation-exchange activity class, soil temperature regime, soil depth, and reaction class. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, superactive, thermic Cumulic Haplustolls

SERIES. The soil series is the lowest category in the soil classification system. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. An example is the Port series, which is classified as a fine-silty, mixed, superactive, thermic Cumulic Haplustoll. The Port series, which occurs in the park, is also the Official State Soil of Oklahoma (see figure 4).

Most parks are mapped to the series level. The names of soil series are selected by the soil scientists during the course of mapping. The series names are commonly geographic place names or are coined. Because of access limitations and soil variability, soils in some remote areas are classified at the great group or subgroup level.

Table 23 indicates the order, suborder, great group, subgroup, and family of the soil series in the park. Table 24 displays the classification as a key sorted by order.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

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

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

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

Alpha,alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

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.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

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

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas 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 or miscellaneous areas are somewhat similar in all areas.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

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

Ecological site. An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water. Water filling all the unblocked pores of the material below the water table.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

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. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or 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 soil material. 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.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

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

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

K_{sat}. Saturated hydraulic conductivity. (See Permeability.)

Leaching. The removal of soluble material from soil or other material by percolating water.

LEP. See Linear extensibility percent.

Linear extensibility (LE). Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at $^1/_3$- or $^1/_{10}$-bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Linear extensibility percent. Refers to the percent change in linear extensibility.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as “saturated hydraulic conductivity,” which is defined in the “Soil Survey Manual.” In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as “permeability.” Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Series, soil. A group of soils that have profiles that are almost alike. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

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.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

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

Sodic (alkali) 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.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to Ca^{++} + Mg^{++}. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Sodium adsorption ratio (SAR). A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

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

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

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.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

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.”

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

Table 1.—Soil Legend

Map unit symbol and map unit name	Components in map unit	Percent of map unit
384742:		
Lincoln fine sandy loam, 0 to 1 percent slopes, frequently flooded	Lincoln	95
	Ezell	5
384751:		
Grandfield-Nobscot complex, 5 to 8 percent slopes	Grandfield	70
	Nobscot	20
	Devol	5
	Eda	5
384753:		
Grandfield-Devol complex, 3 to 5 percent slopes	Grandfield	55
	Devol	40
	Hardeman	3
	Eda	2
384758:		
Clairemont silt loam, 0 to 1 percent slopes, occasionally flooded	Clairemont	95
	Westola	3
	Lincoln	2
384760:		
Eda sand, 0 to 3 percent slopes MLRA 78C	Eda	90
	Devol	4
	Carwile	3
	Delwin	1
	Heatly	1
	Nobscot	1
384762:		
Eda loamy fine sand, 8 to 12 percent slopes	Eda	90
	Devol	5
	Tivoli	5
384769:		
Quinlan-Woodward complex, 5 to 12 percent slopes	Quinlan	65
	Woodward	30
	Cordell	5
384775:		
Devol loamy fine sand, 3 to 8 percent slopes	Devol	95
	Eda	5

Table 1.—Soil Legend—Continued

Map unit symbol and map unit name	Components in map unit	Percent of map unit
384776:		
Devol loamy fine sand, 8 to 12 percent slopes	Devol	90
	Eda	5
	Tivoli	5
384777:		
Port silt loam, 0 to 1 percent slopes, occasionally flooded	Port	90
	Clairemont	5
	Westola	5
384784:		
Woodward fine sandy loam, 3 to 5 percent slopes	Woodward	90
	Dill	5
	Quinlan	5
384785:		
Woodward loam, 1 to 3 percent slopes	Woodward	95
	Carey	5
384792:		
Westola fine sandy loam, 0 to 1 percent slopes, occasionally flooded	Westola	90
	Lincoln	8
	Clairemont	2
1605239:		
Canadian fine sandy loam, 0 to 1 percent slopes, rarely flooded	Canadian	85
	Port	10
	Westola	5

Table 2.—Land Capability Classification

(Land capability classification is a system of grouping soils primarily on the basis of their capability to produce common cultivated crops and pasture plants without deteriorating over a long period of time. Only the soils suitable for cultivation are listed. N indicates nonirrigated areas; I indicates irrigated areas)

Map unit symbol and component name	Land capability N	Land capability I
384742:		
Lincoln	5w	---
384751:		
Grandfield	4e	---
Nobscot	4e	---
384753:		
Grandfield	3e	---
Devol	3e	---
384758:		
Clairemont	2e	1
384760:		
Eda	3e	3e
384762:		
Eda	6e	---
384769:		
Quinlan	6e	---
Woodward	6e	---
384775:		
Devol	4e	---
384776:		
Devol	6e	---
384777:		
Port	2w	---
384784:		
Woodward	3e	---
384785:		
Woodward	3s	---
384792:		
Westola	3e	---
1605239:		
Canadian	1	---

Table 3.—Prime and Other Important Farmland

(Only the soils considered prime or important farmland are listed. Urban or built-up areas of the soils listed are not considered prime or important farmland)

Map unit symbol	Map unit name	Farmland classification
384751	Grandfield-Nobscot complex, 5 to 8 percent slopes	All areas are prime farmland
384753	Grandfield-Devol complex, 3 to 5 percent slopes	All areas are prime farmland
384758	Clairemont silt loam, 0 to 1 percent slopes, occasionally flooded	All areas are prime farmland
384777	Port silt loam, 0 to 1 percent slopes, occasionally flooded	All areas are prime farmland
384784	Woodward fine sandy loam, 3 to 5 percent slopes	All areas are prime farmland
384785	Woodward loam, 1 to 3 percent slopes	All areas are prime farmland
384792	Westola fine sandy loam, 0 to 1 percent slopes, occasionally flooded	All areas are prime farmland
1605239	Canadian fine sandy loam, 0 to 1 percent slopes, rarely flooded	All areas are prime farmland

Table 4.—Hydric Soils

(This report lists only those map unit components that are rated as hydric. Definitions of hydric criteria codes are included at the end of the report)

Map unit symbol and map unit name	Component	Percent of map unit	Landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
384742:							
Lincoln fine sandy loam, 0 to 1 percent slopes, frequently flooded	Ezell	5	flood plains	2B2, 3	Yes	No	Yes

Explanation of hydric criteria codes

1. All Histels (except for Folistels), and Histosols (except for Folists), which are, by definition, saturated.
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Historthels great group, Histoturbels great group, Pachic subgroups, or Cumulic subgroups that:
   - A. are somewhat poorly drained and have a water table at the surface (0.0 feet) during the growing season, or
   - B. are poorly drained or very poorly drained and have either:
     - 1.) a water table at the surface (0.0 feet) during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
     - 2.) a water table at a depth of 0.5 foot or less during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within a depth of 20 inches, or
     - 3.) a water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches.
3. Soils that are frequently ponded for periods of long or very long duration during the growing season.
4. Soils that are frequently flooded for periods of long or very long duration during the growing season.

Table 5.—Landscape, Landform, Parent Material, and Ecological Site

(Component percents may not add up to 100. MAP is the mean annual precipitation)

Map unit symbol and soil name	Percent of map unit	Slope	Elevation	MAP	Landscape	Landform	Parent material	Ecological site name and number
	Pct	Pct	Ft	In				
384742:								
Lincoln	95	0-2	699-2001	22-32	Valley	Flood plain	Calcareous sandy alluvium	Sandy Bottomland 23-30″ PZ, R078CY068OK
384751:								
Grandfield	70	5-8	1001-2001	22-30	Upland	Sand sheet on paleoterrace	Loamy alluvium and/or eolian deposits	Sandy Loam Prairie 23-31″ PZ, R078CY110TX
Nobscot	20	5-8	1001-2500	22-32	Dune field, sandhills, and upland	Dune	Sandy and loamy alluvium and/or eolian deposits	Shinnery Oak Grassland 21 - 28 PZ, R078CY017OK
384753:								
Grandfield	55	3-5	1001-2001	22-30	Upland	Sand sheet on paleoterrace	Loamy alluvium and/or eolian deposits	Sandy Loam Prairie 23-31″ PZ, R078CY110TX
Devol	40	3-5	1001-2500	20-30	Alluvial plain	Dune on sand sheet on stream terrace	Coarse-loamy alluvium and/or sandy eolian deposits	Sandy Loam Prairie 23-31″ PZ, R078CY110TX
384758:								
Clairemont	95	0-1	1001-2251	20-28	Valley	Flood plain	Calcareous silty alluvium	Loamy Bottomland 23-31″ PZ, R078CY103TX
384760:								
Eda	90	0-3	984-2592	22-31	Dune field	Dune	Eolian sands	Shinnery Oak Grassland 21 - 28 PZ, R078CY017OK
384762:								
Eda	90	8-12	1001-2001	22-32	Dune field, sandhills, and upland	Dune	Eolian sands	Deep Sand, R078CY014OK
384769:								
Quinlan	65	5-12	1001-2500	20-28	Upland	Hillslope on hill	Loamy residuum weathered from calcareous sandstone	Shallow Prairie (North) 23-30 PZ, R078CY083OK

Table 5.—Landscape, Landform, Parent Material, and Ecological Site—Continued

Map unit symbol and soil name	Percent of map unit	Slope	Elevation	MAP	Landscape	Landform	Parent material	Ecological site name and number
	Pct	Pct	Ft	In				
384769:								
Woodward-----------	30	5-20	1001-2500	22-32	Upland	Hillslope on hill	Loamy residuum weathered from calcareous sandstone	Loamy Prairie 23-30 PZ, R078CY056OK
384775:								
Devol--------------	95	3-8	1001-2500	20-30	Alluvial plain	Dune on sand sheet on stream terrace	Coarse-loamy alluvium and/or sandy eolian deposits	Deep Sand, R078CY014OK
384776:								
Devol--------------	90	8-12	1001-2500	20-30	Alluvial plain	Dune on sand sheet on stream terrace	Coarse-loamy alluvium and/or sandy eolian deposits	Deep Sand, R078CY014OK
384777:								
Port---------------	90	0-1	699-1499	26-40	Valley	Flood plain	Calcareous loamy alluvium	Loamy Bottomland 23-31” PZ, R078CY103TX
384784:								
Woodward-----------	90	3-5	1001-2500	22-32	Upland	Hillslope on hill	Loamy residuum weathered from calcareous sandstone	Loamy Prairie 23-30 PZ, R078CY056OK
384785:								
Woodward-----------	95	1-3	1001-2500	22-32	Upland	Hillslope on hill	Loamy residuum weathered from calcareous sandstone	Loamy Prairie 23-30 PZ, R078CY056OK
384792:								
Westola------------	90	0-1	1001-2198	22-32	Valley	Flood plain	Calcareous loamy alluvium	Loamy Bottomland 23-31” PZ, R078CY103TX
1605239:								
Canadian-----------	85	0-1	1496-2493	21-33	Valley	Flood plain	Loamy alluvium	Loamy Bottomland PE 44-64, R080AY050OK

Table 6.—Ecological Sites

(Only soils and miscellaneous areas with correlated ecological sites are shown)

Map unit symbol, soil name, and percent of map unit	Ecological site name	Ecological site type	Ecological site ID
384742:			
Lincoln (95%)	Sandy Bottomland 23-30″ PZ	Rangeland	R078CY068OK
Ezell (5%)	Meadow PE 32-44	Rangeland	R078CY090OK
384751:			
Grandfield (70%)	Sandy Loam Prairie 23-31″ PZ	Rangeland	R078CY110TX
Nobscot (20%)	Shinnery Oak Grassland 21 - 28 PZ	Rangeland	R078CY017OK
Devol (5%)	Sandy Loam Prairie 23-31″ PZ	Rangeland	R078CY110TX
Eda (5%)	Deep Sand	Rangeland	R078CY014OK
384753:			
Grandfield (55%)	Sandy Loam Prairie 23-31″ PZ	Rangeland	R078CY110TX
Devol (40%)	Sandy Loam Prairie 23-31″ PZ	Rangeland	R078CY110TX
Hardeman (3%)	Sandy Loam Prairie 23-31″ PZ	Rangeland	R078CY110TX
Eda (2%)	Deep Sand	Rangeland	R078CY014OK
384758:			
Clairemont (95%)	Loamy Bottomland 23-31″ PZ	Rangeland	R078CY103TX
Westola (3%)	Loamy Bottomland 23-31″ PZ	Rangeland	R078CY103TX
Lincoln (2%)	Sandy Bottomland 23-30″ PZ	Rangeland	R078CY068OK
384760:			
Eda (90%)	Shinnery Oak Grassland 21 - 28 PZ	Rangeland	R078CY017OK
384762:			
Eda (90%)	Deep Sand	Rangeland	R078CY014OK
Devol (5%)	Sandy Loam Prairie 23-31″ PZ	Rangeland	R078CY110TX
Tivoli (5%)	Deep Sand	Rangeland	R078CY014OK
384769:			
Quinlan (65%)	Shallow Prairie (North) 23-30 PZ	Rangeland	R078CY083OK
Woodward (30%)	Loamy Prairie 23-30 PZ	Rangeland	R078CY056OK
Cordell (5%)	Red Shale PE 32-44	Rangeland	R078CY067OK
384775:			
Devol (95%)	Deep Sand	Rangeland	R078CY014OK
Eda (5%)	Deep Sand	Rangeland	R078CY014OK
384776:			
Devol (90%)	Deep Sand	Rangeland	R078CY014OK
Eda (5%)	Deep Sand	Rangeland	R078CY014OK
Tivoli (5%)	Deep Sand	Rangeland	R078CY014OK

Table 6.—Ecological Sites—Continued

Map unit symbol, soil name, and percent of map unit	Ecological site name	Ecological site type	Ecological site ID
384777:			
Port (90%)	Loamy Bottomland 23-31″ PZ	Rangeland	R078CY103TX
Clairemont (5%)	Loamy Bottomland 23-31″ PZ	Rangeland	R078CY103TX
Westola (5%)	Loamy Bottomland 23-31″ PZ	Rangeland	R078CY103TX
384784:			
Woodward (90%)	Loamy Prairie 23-30 PZ	Rangeland	R078CY056OK
Dill (5%)	Sandy Loam Prairie 23-31″ PZ	Rangeland	R078CY110TX
Quinlan (5%)	Shallow Prairie (North) 23-30 PZ	Rangeland	R078CY083OK
384785:			
Woodward (95%)	Loamy Prairie 23-30 PZ	Rangeland	R078CY056OK
Carey (5%)	Loamy Prairie 23-30 PZ	Rangeland	R078CY056OK
384792:			
Westola (90%)	Loamy Bottomland 23-31″ PZ	Rangeland	R078CY103TX
Lincoln (8%)	Sandy Bottomland 23-30″ PZ	Rangeland	R078CY068OK
Clairemont (2%)	Loamy Bottomland 23-31″ PZ	Rangeland	R078CY103TX
1605239:			
Canadian (85%)	Loamy Bottomland PE 44-64	Rangeland	R080AY050OK
Port (10%)	Loamy Bottomland PE 44-64	Rangeland	R080AY050OK
Westola (5%)	Loamy Bottomland 23-31″ PZ	Rangeland	R078CY103TX

Table 7.—Rangeland Productivity

(Only the soils that support rangeland vegetation suitable for grazing are rated)

Map unit symbol and soil name	Ecological site and symbol	Total dry-weight production		
		Favorable year	Normal year	Unfavorable year
		Lb/acre	Lb/acre	Lb/acre
384742:				
Lincoln	Sandy Bottomland 23-30″ PZ (R078CY068OK)	3,000	2,300	1,800
384751:				
Grandfield	Sandy Loam Prairie 23-31″ PZ (R078CY110TX)	3,600	2,700	1,800
Nobscot	Shinnery Oak Grassland 21 - 28 PZ (R078CY017OK)	5,000	4,000	3,000
384753:				
Grandfield	Sandy Loam Prairie 23-31″ PZ (R078CY110TX)	3,600	2,700	1,800
Devol	Sandy Loam Prairie 23-31″ PZ (R078CY110TX)	3,600	2,700	1,800
384758:				
Clairemont	Loamy Bottomland 23-31″ PZ (R078CY103TX)	8,000	5,000	3,000
384760:				
Eda	Shinnery Oak Grassland 21 - 28 PZ (R078CY017OK)	5,000	4,000	3,000
384762:				
Eda	Deep Sand (R078CY014OK)	3,500	2,400	1,700
384769:				
Quinlan	Shallow Prairie (North) 23-30 PZ (R078CY083OK)	2,500	1,800	1,300
Woodward	Loamy Prairie 23-30 PZ (R078CY056OK)	5,800	4,200	3,500
384775:				
Devol	Deep Sand (R078CY014OK)	3,500	2,400	1,700
384776:				
Devol	Deep Sand (R078CY014OK)	3,500	2,400	1,700
384777:				
Port	Loamy Bottomland 23-31″ PZ (R078CY103TX)	8,000	5,000	3,000
384784:				
Woodward	Loamy Prairie 23-30 PZ (R078CY056OK)	5,800	4,200	3,500
384785:				
Woodward	Loamy Prairie 23-30 PZ (R078CY056OK)	5,800	4,200	3,500

Table 7.—Rangeland Productivity—Continued

Map unit symbol and soil name	Ecological site and symbol	Total dry-weight production		
		Favorable year	Normal year	Unfavorable year
		Lb/acre	Lb/acre	Lb/acre
384792:				
Westola	Loamy Bottomland 23-31” PZ (R078CY103TX)	8,000	5,000	3,000
1605239:				
Canadian	Loamy Bottomland PE 44-64 (R080AY050OK)	8,500	6,100	4,500

Table 8.—Land Management, Part I (Planting)

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Suitability for hand planting: Rating class and limiting features	Value	Suitability for mechanical planting: Rating class and limiting features	Value	Soil rutting hazard: Rating class and limiting features	Value
384742:							
Lincoln	95	Well suited		Well suited		Severe	
						Low strength	1.00
384751:							
Grandfield	70	Well suited		Moderately suited		Severe	
				Slope	0.50	Low strength	1.00
Nobscot	20	Well suited		Moderately suited		Moderate	
				Slope	0.50	Low strength	0.50
384753:							
Grandfield	55	Well suited		Well suited		Severe	
						Low strength	1.00
Devol	40	Well suited		Well suited		Severe	
						Low strength	1.00
384758:							
Clairemont	95	Well suited		Well suited		Severe	
						Low strength	1.00
384760:							
Eda	90	Moderately suited		Moderately suited		Moderate	
		Sandiness	0.50	Sandiness	0.50	Low strength	0.50
384762:							
Eda	90	Well suited		Moderately suited		Moderate	
				Slope	0.50	Low strength	0.50
384769:							
Quinlan	65	Well suited		Moderately suited		Severe	
				Slope	0.50	Low strength	1.00
Woodward	30	Well suited		Moderately suited		Severe	
				Slope	0.50	Low strength	1.00
384775:							
Devol	95	Well suited		Moderately suited		Moderate	
				Slope	0.50	Low strength	0.50
384776:							
Devol	90	Well suited		Moderately suited		Moderate	
				Slope	0.50	Low strength	0.50
384777:							
Port	90	Well suited		Well suited		Severe	
						Low strength	1.00
384784:							
Woodward	90	Well suited		Well suited		Severe	
						Low strength	1.00

Table 8.—Land Management, Part I (Planting)—Continued

Map unit symbol and soil name	Pct. of map unit	Suitability for hand planting: Rating class and limiting features	Suitability for hand planting: Value	Suitability for mechanical planting: Rating class and limiting features	Suitability for mechanical planting: Value	Soil rutting hazard: Rating class and limiting features	Soil rutting hazard: Value
384785:							
Woodward	95	Well suited		Well suited		Severe	
						Low strength	1.00
384792:							
Westola	90	Well suited		Well suited		Severe	
						Low strength	1.00
1605239:							
Canadian	85	Well suited		Well suited		Severe	
						Low strength	1.00

Table 8.—Land Management, Part II (Hazard of Erosion and Suitability for Roads)

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Hazard of erosion		Hazard of erosion on roads and trails		Suitability for roads (natural surface)	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
384742:							
Lincoln	95	Slight		Slight		Poorly suited	
						Flooding	1.00
						Low strength	0.50
384751:							
Grandfield	70	Slight		Moderate		Moderately suited	
				Slope/erodibility	0.50	Low strength	0.50
						Slope	0.50
						Dusty	0.08
Nobscot	20	Slight		Moderate		Moderately suited	
				Slope/erodibility	0.50	Slope	0.50
384753:							
Grandfield	55	Slight		Moderate		Moderately suited	
				Slope/erodibility	0.50	Low strength	0.50
						Dusty	0.08
Devol	40	Slight		Slight		Moderately suited	
						Low strength	0.50
						Dusty	0.04
384758:							
Clairemont	95	Slight		Slight		Poorly suited	
						Flooding	1.00
						Low strength	0.50
						Dusty	0.49
384760:							
Eda	90	Slight		Slight		Moderately suited	
						Sandiness	0.50
384762:							
Eda	90	Slight		Moderate		Moderately suited	
				Slope/erodibility	0.50	Slope	0.50
384769:							
Quinlan	65	Slight		Severe		Moderately suited	
				Slope/erodibility	0.95	Low strength	0.50
						Slope	0.50
						Dusty	0.34
Woodward	30	Moderate		Severe		Poorly suited	
		Slope/erodibility	0.50	Slope/erodibility	0.95	Slope	1.00
						Low strength	0.50
						Dusty	0.33
384775:							
Devol	95	Slight		Moderate		Moderately suited	
				Slope/erodibility	0.50	Slope	0.50
384776:							
Devol	90	Slight		Moderate		Moderately suited	
				Slope/erodibility	0.50	Slope	0.50

Table 8.—Land Management, Part II (Hazard of Erosion and Suitability for Roads)—Continued

Map unit symbol and soil name	Pct. of map unit	Hazard of erosion: Rating class and limiting features	Value	Hazard of erosion on roads and trails: Rating class and limiting features	Value	Suitability for roads (natural surface): Rating class and limiting features	Value
384777:							
Port	90	Slight		Slight		Poorly suited	
						Flooding	1.00
						Low strength	0.50
						Dusty	0.33
384784:							
Woodward	90	Slight		Moderate		Moderately suited	
				Slope/erodibility	0.50	Low strength	0.50
						Dusty	0.33
384785:							
Woodward	95	Slight		Slight		Moderately suited	
						Low strength	0.50
						Dusty	0.33
384792:							
Westola	90	Slight		Slight		Poorly suited	
						Flooding	1.00
						Low strength	0.50
						Dusty	0.05
1605239:							
Canadian	85	Slight		Slight		Moderately suited	
						Low strength	0.50
						Dusty	0.05

Table 8.—Land Management, Part III (Site Preparation)

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Suitability for mechanical site preparation (deep)		Suitability for mechanical site preparation (surface)	
		Rating class and limiting features	Value	Rating class and limiting features	Value
384742:					
Lincoln	95	Well suited		Well suited	
384751:					
Grandfield	70	Well suited		Well suited	
Nobscot	20	Well suited		Well suited	
384753:					
Grandfield	55	Well suited		Well suited	
Devol	40	Well suited		Well suited	
384758:					
Clairemont	95	Well suited		Well suited	
384760:					
Eda	90	Well suited		Well suited	
384762:					
Eda	90	Well suited		Well suited	
384769:					
Quinlan	65	Well suited		Well suited	
Woodward	30	Well suited		Well suited	
384775:					
Devol	95	Well suited		Well suited	
384776:					
Devol	90	Well suited		Well suited	
384777:					
Port	90	Well suited		Well suited	
384784:					
Woodward	90	Well suited		Well suited	
384785:					
Woodward	95	Well suited		Well suited	
384792:					
Westola	90	Well suited		Well suited	
1605239:					
Canadian	85	Well suited		Well suited	

Table 8.—Land Management, Part IV (Site Restoration)

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Potential for damage to soil by fire: Rating class and limiting features	Value	Potential for seedling mortality: Rating class and limiting features	Value
384742:					
Lincoln	95	Low		High	
				Available water	1.00
				Soil reaction	0.50
384751:					
Grandfield	70	Low		High	
				Available water	1.00
Nobscot	20	High		High	
		Texture/rock fragments	1.00	Available water	1.00
384753:					
Grandfield	55	Low		High	
				Available water	1.00
Devol	40	Low		High	
				Available water	1.00
384758:					
Clairemont	95	Low		Moderate	
				Soil reaction	0.50
				Available water	0.50
384760:					
Eda	90	High		High	
		Texture/rock fragments	1.00	Available water	1.00
384762:					
Eda	90	High		High	
		Texture/rock fragments	1.00	Available water	1.00
384769:					
Quinlan	65	Low		High	
				Available water	1.00
				Soil reaction	0.50
Woodward	30	Low		Moderate	
				Available water	0.50
384775:					
Devol	95	High		High	
		Texture/rock fragments	1.00	Available water	1.00
384776:					
Devol	90	High		High	
		Texture/rock fragments	1.00	Available water	1.00

Table 8.—Land Management, Part IV (Site Restoration)—Continued

Map unit symbol and soil name	Pct. of map unit	Potential for damage to soil by fire		Potential for seedling mortality	
		Rating class and limiting features	Value	Rating class and limiting features	Value
384777:					
Port	90	Low		Low	
384784:					
Woodward	90	Low		Moderate	
				Available water	0.50
384785:					
Woodward	95	Low		Moderate	
				Available water	0.50
384792:					
Westola	90	Low		Moderate	
				Available water	0.50
				Soil reaction	0.50
1605239:					
Canadian	85	Low		High	
				Available water	1.00

Table 9.—Recreation, Part I (Camp and Picnic Areas)

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Camp areas		Picnic areas	
		Rating class and limiting features	Value	Rating class and limiting features	Value
384742:					
Lincoln	95	Very limited		Somewhat limited	
		Flooding	1.00	Flooding	0.40
384751:					
Grandfield	70	Somewhat limited		Somewhat limited	
		Dusty	0.08	Dusty	0.08
Nobscot	20	Somewhat limited		Somewhat limited	
		Too sandy	0.96	Too sandy	0.96
384753:					
Grandfield	55	Somewhat limited		Somewhat limited	
		Dusty	0.08	Dusty	0.08
Devol	40	Somewhat limited		Somewhat limited	
		Dusty	0.04	Dusty	0.04
384758:					
Clairemont	95	Very limited		Somewhat limited	
		Flooding	1.00	Dusty	0.49
		Dusty	0.49		
384760:					
Eda	90	Very limited		Very limited	
		Too sandy	1.00	Too sandy	1.00
384762:					
Eda	90	Somewhat limited		Somewhat limited	
		Too sandy	0.37	Too sandy	0.37
		Slope	0.16	Slope	0.16
384769:					
Quinlan	65	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00
		Dusty	0.34	Dusty	0.34
		Slope	0.04	Slope	0.04
Woodward	30	Somewhat limited		Somewhat limited	
		Slope	0.84	Slope	0.84
		Dusty	0.33	Dusty	0.33
384775:					
Devol	95	Somewhat limited		Somewhat limited	
		Too sandy	0.37	Too sandy	0.37
384776:					
Devol	90	Somewhat limited		Somewhat limited	
		Too sandy	0.37	Too sandy	0.37
		Slope	0.16	Slope	0.16

Table 9.—Recreation, Part I (Camp and Picnic Areas)—Continued

Map unit symbol and soil name	Pct. of map unit	Camp areas: Rating class and limiting features	Camp areas: Value	Picnic areas: Rating class and limiting features	Picnic areas: Value
384777:					
Port	90	Very limited		Somewhat limited	
		Flooding	1.00	Dusty	0.33
		Dusty	0.33		
384784:					
Woodward	90	Somewhat limited		Somewhat limited	
		Dusty	0.33	Dusty	0.33
384785:					
Woodward	95	Somewhat limited		Somewhat limited	
		Dusty	0.33	Dusty	0.33
384792:					
Westola	90	Very limited		Somewhat limited	
		Flooding	1.00	Dusty	0.05
		Dusty	0.05		
1605239:					
Canadian	85	Very limited		Somewhat limited	
		Flooding	1.00	Dusty	0.05
		Dusty	0.05		

Table 9.—Recreation, Part II (Trail Management)

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Foot traffic and equestrian trails: Rating class and limiting features	Foot traffic and equestrian trails: Value	Mountain bike and off-road vehicle trails: Rating class and limiting features	Mountain bike and off-road vehicle trails: Value
384742:					
Lincoln	95	Somewhat limited		Somewhat limited	
		Flooding	0.40	Flooding	0.40
384751:					
Grandfield	70	Somewhat limited		Somewhat limited	
		Dusty	0.08	Dusty	0.08
Nobscot	20	Somewhat limited		Somewhat limited	
		Too sandy	0.96	Too sandy	0.96
384753:					
Grandfield	55	Somewhat limited		Somewhat limited	
		Dusty	0.08	Dusty	0.08
Devol	40	Somewhat limited		Somewhat limited	
		Dusty	0.04	Dusty	0.04
384758:					
Clairemont	95	Somewhat limited		Somewhat limited	
		Dusty	0.49	Dusty	0.49
384760:					
Eda	90	Very limited		Very limited	
		Too sandy	1.00	Too sandy	1.00
384762:					
Eda	90	Somewhat limited		Somewhat limited	
		Too sandy	0.37	Too sandy	0.37
384769:					
Quinlan	65	Very limited		Very limited	
		Water erosion	1.00	Water erosion	1.00
		Dusty	0.34	Dusty	0.34
Woodward	30	Very limited		Very limited	
		Water erosion	1.00	Water erosion	1.00
		Dusty	0.33	Dusty	0.33
384775:					
Devol	95	Somewhat limited		Somewhat limited	
		Too sandy	0.37	Too sandy	0.37
384776:					
Devol	90	Somewhat limited		Somewhat limited	
		Too sandy	0.37	Too sandy	0.37
384777:					
Port	90	Somewhat limited		Somewhat limited	
		Dusty	0.33	Dusty	0.33
384784:					
Woodward	90	Somewhat limited		Somewhat limited	
		Dusty	0.33	Dusty	0.33

Table 9.—Recreation, Part II (Trail Management)—Continued

Map unit symbol and soil name	Pct. of map unit	Foot traffic and equestrian trails: Rating class and limiting features	Foot traffic and equestrian trails: Value	Mountain bike and off-road vehicle trails: Rating class and limiting features	Mountain bike and off-road vehicle trails: Value
384785:					
Woodward	95	Somewhat limited		Somewhat limited	
		Dusty	0.33	Dusty	0.33
384792:					
Westola	90	Somewhat limited		Somewhat limited	
		Dusty	0.05	Dusty	0.05
1605239:					
Canadian	85	Somewhat limited		Somewhat limited	
		Dusty	0.05	Dusty	0.05

Table 10.—Dwellings and Small Commercial Buildings

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Dwellings without basements		Dwellings with basements		Small commercial buildings	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
384742:							
Lincoln	95	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
384751:							
Grandfield	70	Not limited		Not limited		Somewhat limited	
						Slope	0.88
Nobscot	20	Not limited		Not limited		Somewhat limited	
						Slope	0.88
384753:							
Grandfield	55	Not limited		Not limited		Not limited	
Devol	40	Not limited		Not limited		Not limited	
384758:							
Clairemont	95	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
384760:							
Eda	90	Not limited		Not limited		Not limited	
384762:							
Eda	90	Somewhat limited		Somewhat limited		Very limited	
		Slope	0.16	Slope	0.16	Slope	1.00
384769:							
Quinlan	65	Somewhat limited		Very limited		Very limited	
		Depth to soft bedrock	0.50	Depth to soft bedrock	1.00	Depth to soft bedrock	1.00
		Slope	0.04	Slope	0.04	Slope	1.00
Woodward	30	Somewhat limited		Somewhat limited		Very limited	
		Slope	0.84	Depth to soft bedrock	0.90	Slope	1.00
				Slope	0.84		
384775:							
Devol	95	Not limited		Not limited		Somewhat limited	
						Slope	0.50
384776:							
Devol	90	Somewhat limited		Somewhat limited		Very limited	
		Slope	0.16	Slope	0.16	Slope	1.00
384777:							
Port	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
384784:							
Woodward	90	Not limited		Somewhat limited		Not limited	
				Depth to soft bedrock	0.90		

Table 10.—Dwellings and Small Commercial Buildings—Continued

Map unit symbol and soil name	Pct. of map unit	Dwellings without basements: Rating class and limiting features	Value	Dwellings with basements: Rating class and limiting features	Value	Small commercial buildings: Rating class and limiting features	Value
384785:							
Woodward	95	Not limited		Somewhat limited		Not limited	
				Depth to soft bedrock	0.90		
384792:							
Westola	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
1605239:							
Canadian	85	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00

Table 11.—Roads and Streets, Shallow Excavations, and Landscaping

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
384742:							
Lincoln	95	Very limited		Somewhat limited		Very limited	
		Flooding	1.00	Flooding	0.80	Flooding	1.00
				Unstable excavation walls	0.01	Droughty	0.56
384751:							
Grandfield	70	Not limited		Somewhat limited		Somewhat limited	
				Dusty	0.08	Dusty	0.08
				Unstable excavation walls	0.01		
Nobscot	20	Not limited		Somewhat limited		Somewhat limited	
				Unstable excavation walls	0.71	Droughty	0.12
384753:							
Grandfield	55	Not limited		Somewhat limited		Somewhat limited	
				Dusty	0.08	Dusty	0.08
				Unstable excavation walls	0.01		
Devol	40	Not limited		Somewhat limited		Somewhat limited	
				Dusty	0.04	Dusty	0.04
				Unstable excavation walls	0.01		
384758:							
Clairemont	95	Very limited		Somewhat limited		Somewhat limited	
		Flooding	1.00	Flooding	0.60	Flooding	0.60
		Low strength	1.00	Dusty	0.49	Dusty	0.49
				Unstable excavation walls	0.01		
384760:							
Eda	90	Not limited		Very limited		Somewhat limited	
				Unstable excavation walls	1.00	Droughty	0.91
						Too sandy	0.50
384762:							
Eda	90	Somewhat limited		Somewhat limited		Somewhat limited	
		Slope	0.16	Slope	0.16	Droughty	0.52
				Unstable excavation walls	0.13	Slope	0.16
384769:							
Quinlan	65	Somewhat limited		Very limited		Very limited	
		Depth to soft bedrock	1.00	Depth to soft bedrock	1.00	Depth to bedrock	1.00
						Droughty	0.96
		Slope	0.04	Dense layer	0.50	Dusty	0.34
				Dusty	0.34	Slope	0.04
				Slope	0.04		
				Unstable excavation walls	0.01		

Table 11.—Roads and Streets, Shallow Excavations, and Landscaping—Continued

Map unit symbol and soil name	Pct. of map unit	Local roads and streets: Rating class and limiting features	Value	Shallow excavations: Rating class and limiting features	Value	Landscaping: Rating class and limiting features	Value
384769:							
Woodward------------	30	Somewhat limited		Somewhat limited		Somewhat limited	
		Slope	0.84	Depth to soft bedrock	0.90	Depth to bedrock	0.90
				Slope	0.84	Slope	0.84
				Dense layer	0.50	Dusty	0.33
				Dusty	0.33		
				Unstable excavation walls	0.01		
384775:							
Devol---------------	95	Not limited		Somewhat limited		Not limited	
				Unstable excavation walls	0.02		
384776:							
Devol---------------	90	Somewhat limited		Somewhat limited		Somewhat limited	
		Slope	0.16	Slope	0.16	Slope	0.16
				Unstable excavation walls	0.02		
384777:							
Port----------------	90	Very limited		Somewhat limited		Somewhat limited	
		Flooding	1.00	Flooding	0.60	Flooding	0.60
		Low strength	1.00	Dusty	0.33	Dusty	0.33
				Unstable excavation walls	0.01		
384784:							
Woodward------------	90	Not limited		Somewhat limited		Somewhat limited	
				Depth to soft bedrock	0.90	Depth to bedrock	0.90
				Dense layer	0.50	Dusty	0.33
				Dusty	0.33		
				Unstable excavation walls	0.01		
384785:							
Woodward------------	95	Not limited		Somewhat limited		Somewhat limited	
				Depth to soft bedrock	0.90	Depth to bedrock	0.90
				Dense layer	0.50	Dusty	0.33
				Dusty	0.33		
				Unstable excavation walls	0.01		
384792:							
Westola-------------	90	Very limited		Somewhat limited		Somewhat limited	
		Flooding	1.00	Flooding	0.60	Flooding	0.60
				Dusty	0.05	Dusty	0.05
				Unstable excavation walls	0.01		
1605239:							
Canadian------------	85	Somewhat limited		Somewhat limited		Somewhat limited	
		Flooding	0.40	Dusty	0.05	Dusty	0.05
				Unstable excavation walls	0.01		

Table 12.—Sewage Disposal

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Septic tank absorption fields: Rating class and limiting features	Value	Sewage lagoons: Rating class and limiting features	Value
384742:					
Lincoln	95	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Filtering capacity	1.00	Seepage	1.00
		Seepage, bottom layer	1.00		
384751:					
Grandfield	70	Very limited		Very limited	
		Seepage, bottom layer	1.00	Seepage	1.00
				Slope	1.00
		Slow water movement	0.46		
Nobscot	20	Very limited		Very limited	
		Seepage, bottom layer	1.00	Seepage	1.00
				Slope	1.00
384753:					
Grandfield	55	Very limited		Very limited	
		Seepage, bottom layer	1.00	Seepage	1.00
				Slope	0.32
		Slow water movement	0.46		
Devol	40	Very limited		Very limited	
		Seepage, bottom layer	1.00	Seepage	1.00
				Slope	0.32
384758:					
Clairemont	95	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Slow water movement	0.46	Seepage	0.53
384760:					
Eda	90	Very limited		Very limited	
		Filtering capacity	1.00	Seepage	1.00
		Seepage, bottom layer	1.00		
384762:					
Eda	90	Very limited		Very limited	
		Filtering capacity	1.00	Slope	1.00
				Seepage	1.00
		Seepage, bottom layer	1.00		
		Slope	0.16		

Table 12.—Sewage Disposal—Continued

Map unit symbol and soil name	Pct. of map unit	Septic tank absorption fields: Rating class and limiting features	Value	Sewage lagoons: Rating class and limiting features	Value
384769:					
Quinlan	65	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
		Seepage, bottom layer	1.00	Slope	1.00
		Slope	0.04	Seepage	1.00
Woodward	30	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
		Slope	0.84	Slope	1.00
		Slow water movement	0.46	Seepage	0.53
384775:					
Devol	95	Very limited		Very limited	
		Seepage, bottom layer	1.00	Seepage	1.00
				Slope	0.92
384776:					
Devol	90	Very limited		Very limited	
		Seepage, bottom layer	1.00	Slope	1.00
		Slope	0.16	Seepage	1.00
384777:					
Port	90	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Slow water movement	0.46	Seepage	0.53
384784:					
Woodward	90	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
		Slow water movement	0.46	Seepage	0.53
				Slope	0.32
384785:					
Woodward	95	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
		Slow water movement	0.46	Seepage	0.53
384792:					
Westola	90	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Seepage, bottom layer	1.00	Seepage	1.00
1605239:					
Canadian	85	Very limited		Very limited	
		Seepage, bottom layer	1.00	Seepage	1.00
		Flooding	0.40	Flooding	0.40

Table 13.—Source of Gravel and Sand

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The ratings given for the thickest layer are for the thickest layer above and excluding the bottom layer. The numbers in the value columns range from 0.00 to 0.99. The greater the value, the greater the likelihood that the bottom layer or thickest layer of the soil is a source of sand or gravel. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Gravel source: Rating class and limiting features	Gravel source: Value	Sand source: Rating class and limiting features	Sand source: Value
384742:					
Lincoln	95	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.05
		Thickest layer	0.00	Thickest layer	0.18
384751:					
Grandfield	70	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.07
Nobscot	20	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.14
		Thickest layer	0.00	Thickest layer	0.67
384753:					
Grandfield	55	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.07
Devol	40	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.05
		Thickest layer	0.00	Thickest layer	0.13
384758:					
Clairemont	95	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
384760:					
Eda	90	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.26
		Thickest layer	0.00	Thickest layer	0.86
384762:					
Eda	90	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.02
		Thickest layer	0.00	Thickest layer	0.19
384769:					
Quinlan	65	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Woodward	30	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
384775:					
Devol	95	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.05
		Thickest layer	0.00	Thickest layer	0.17

Table 13.—Source of Gravel and Sand—Continued

Map unit symbol and soil name	Pct. of map unit	Gravel source		Sand source	
		Rating class and limiting features	Value	Rating class and limiting features	Value
384776:					
Devol	90	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.05
		Thickest layer	0.00	Thickest layer	0.17
384777:					
Port	90	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
384784:					
Woodward	90	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
384785:					
Woodward	95	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
384792:					
Westola	90	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.03
1605239:					
Canadian	85	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.07

Table 14.—Source of Reclamation Material, Roadfill, and Topsoil

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.00 to 0.99. The smaller the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Source of reclamation material: Rating class and limiting features	Value	Roadfill source: Rating class and limiting features	Value	Topsoil source: Rating class and limiting features	Value
384742:							
Lincoln	95	Fair		Good		Fair	
		Low content of organic matter	0.13			Too sandy	0.64
		Too sandy	0.64				
		Droughty	0.79				
384751:							
Grandfield	70	Fair		Good		Good	
		Low content of organic matter	0.13				
Nobscot	20	Poor		Good		Poor	
		Wind erosion	0.00			Too sandy	0.00
		Too sandy	0.00				
		Too acid	0.84				
384753:							
Grandfield	55	Fair		Good		Good	
		Low content of organic matter	0.13				
Devol	40	Fair		Good		Good	
		Low content of organic matter	0.13				
384758:							
Clairemont	95	Fair		Poor		Good	
		Water erosion	0.90	Low strength	0.00		
				Dusty	0.74		
384760:							
Eda	90	Poor		Good		Poor	
		Too sandy	0.00			Too sandy	0.00
		Wind erosion	0.00				
		Low content of organic matter	0.13				
384762:							
Eda	90	Poor		Good		Fair	
		Wind erosion	0.00			Too sandy	0.33
		Low content of organic matter	0.13			Slope	0.84
		Too sandy	0.33				
384769:							
Quinlan	65	Poor		Poor		Poor	
		Droughty	0.00	Depth to bedrock	0.00	Depth to bedrock	0.00
		Depth to bedrock	0.00	Dusty	0.85	Slope	0.96
		Low content of organic matter	0.88				

Table 14.—Source of Reclamation Material, Roadfill, and Topsoil—Continued

Map unit symbol and soil name	Pct. of map unit	Source of reclamation material: Rating class and limiting features	Value	Roadfill source: Rating class and limiting features	Value	Topsoil source: Rating class and limiting features	Value
384769:							
Woodward	30	Fair		Poor		Fair	
		Depth to bedrock	0.10	Depth to bedrock	0.00	Depth to bedrock	0.10
		Low content of organic matter	0.13	Dusty	0.85	Slope	0.16
		Droughty	0.66				
384775:							
Devol	95	Poor		Good		Fair	
		Wind erosion	0.00			Too sandy	0.99
		Low content of organic matter	0.13				
		Too sandy	0.99				
384776:							
Devol	90	Poor		Good		Fair	
		Wind erosion	0.00			Slope	0.84
		Low content of organic matter	0.13			Too sandy	0.99
		Too sandy	0.99				
384777:							
Port	90	Fair		Poor		Good	
		Low content of organic matter	0.50	Low strength	0.00		
				Dusty	0.77		
		Water erosion	0.99	Shrink-swell	0.90		
384784:							
Woodward	90	Fair		Poor		Fair	
		Depth to bedrock	0.10	Depth to bedrock	0.00	Depth to bedrock	0.10
		Low content of organic matter	0.13	Dusty	0.85		
		Droughty	0.66				
384785:							
Woodward	95	Fair		Poor		Fair	
		Depth to bedrock	0.10	Depth to bedrock	0.00	Depth to bedrock	0.10
		Low content of organic matter	0.13	Dusty	0.85		
		Droughty	0.66				
384792:							
Westola	90	Fair		Good		Good	
		Low content of organic matter	0.13				
1605239:							
Canadian	85	Fair		Good		Good	
		Low content of organic matter	0.50				

Table 15.—Ponds and Embankments

(Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table)

Map unit symbol and soil name	Pct. of map unit	Pond reservoir areas: Rating class and limiting features	Value	Embankments, dikes, and levees: Rating class and limiting features	Value	Aquifer-fed excavated ponds: Rating class and limiting features	Value
384742:							
Lincoln	95	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.92	Depth to water	1.00
384751:							
Grandfield	70	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Dusty	0.08	Depth to water	1.00
		Slope	0.92				
Nobscot	20	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Seepage	0.52	Depth to water	1.00
		Slope	0.92				
384753:							
Grandfield	55	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Dusty	0.08	Depth to water	1.00
		Slope	0.08				
Devol	40	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Dusty	0.04	Depth to water	1.00
		Slope	0.08				
384758:							
Clairemont	95	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.72	Piping	0.95	Depth to water	1.00
				Dusty	0.49		
384760:							
Eda	90	Very limited		Very limited		Very limited	
		Seepage	1.00	Seepage	1.00	Depth to water	1.00
384762:							
Eda	90	Very limited		Very limited		Very limited	
		Seepage	1.00	Seepage	1.00	Depth to water	1.00
		Slope	1.00				
384769:							
Quinlan	65	Very limited		Very limited		Very limited	
		Slope	1.00	Thin layer	1.00	Depth to water	1.00
		Depth to bedrock	0.74	Piping	1.00		
		Seepage	0.04	Dusty	0.34		
Woodward	30	Very limited		Very limited		Very limited	
		Slope	1.00	Piping	1.00	Depth to water	1.00
		Seepage	0.72	Thin layer	0.98		
		Depth to bedrock	0.30	Dusty	0.33		
384775:							
Devol	95	Very limited		Not limited		Very limited	
		Seepage	1.00			Depth to water	1.00
		Slope	0.68				
384776:							
Devol	90	Very limited		Not limited		Very limited	
		Seepage	1.00			Depth to water	1.00
		Slope	1.00				

Table 15.—Ponds and Embankments—Continued

Map unit symbol and soil name	Pct. of map unit	Pond reservoir areas		Embankments, dikes, and levees		Aquifer-fed excavated ponds	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
384777:							
Port	90	Somewhat limited		Somewhat limited		Very limited	
		Seepage	0.72	Piping	0.70	Depth to water	1.00
				Dusty	0.33		
384784:							
Woodward	90	Somewhat limited		Very limited		Very limited	
		Seepage	0.72	Piping	1.00	Depth to water	1.00
		Depth to bedrock	0.30	Thin layer	0.98		
		Slope	0.08	Dusty	0.33		
384785:							
Woodward	95	Somewhat limited		Very limited		Very limited	
		Seepage	0.72	Piping	1.00	Depth to water	1.00
		Depth to bedrock	0.30	Thin layer	0.98		
				Dusty	0.33		
384792:							
Westola	90	Very limited		Very limited		Very limited	
		Seepage	1.00	Piping	1.00	Depth to water	1.00
				Dusty	0.05		
1605239:							
Canadian	85	Very limited		Somewhat limited		Very limited	
		Seepage	1.00	Dusty	0.05	Depth to water	1.00

Table 16.—Engineering Properties

(Absence of an entry indicates that data were not estimated)

Map unit symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 in	3-10 in	4	10	40	200		
	In				Pct	Pct					Pct	
384742:												
Lincoln---------	0-12	Fine sandy loam	SC-SM, SM, CL-ML, ML	A-4	0	0	95-100	85-100	80-100	36-60	15-24	NP-7
	12-80	Stratified fine sand to clay loam	SP-SM, SM	A-3, A-2	0	0	95-100	85-100	82-100	5-35	0-34	NP-10
384751:												
Grandfield------	0-6	Fine sandy loam	SC-SM, SM, CL-ML, ML	A-4	0	0	100	98-100	94-100	36-60	15-26	NP-7
	6-12	Fine sandy loam, sandy clay loam	SC, SM, CL, ML	A-6, A-4	0	0	100	98-100	90-100	36-65	15-37	NP-16
	12-32	Sandy clay loam, fine sandy loam	SC, SM, CL, ML	A-6, A-4	0	0	100	98-100	90-100	36-65	15-37	NP-16
	32-80	Fine sandy loam, sandy clay loam	SC, SM, CL, ML	A-4	0	0	100	98-100	90-100	36-60	15-30	NP-10
Nobscot---------	0-5	Loamy fine sand	SM	A-2	0	0	100	95-100	90-100	15-35	0-14	NP
	5-34	Fine sand, loamy fine sand, loamy sand	SP-SM, SM	A-3, A-2	0	0	100	95-100	80-100	3-35	0-14	NP
	34-44	Fine sandy loam, sandy loam	SC-SM, SM, CL-ML, ML	A-4	0	0	100	95-100	90-100	36-60	15-26	NP-7
	44-54	Loamy fine sand, loamy sand, fine sand	SP-SM, SM	A-3, A-2	0	0	100	95-100	80-100	3-35	0-14	NP
	54-70	Fine sand, loamy sand, loamy fine sand	SP-SM, SM	A-3, A-2	0	0	100	95-100	80-100	3-35	0-14	NP
384753:												
Grandfield------	0-6	Fine sandy loam	SC-SM, SM, CL-ML, ML	A-4	0	0	100	98-100	94-100	36-60	15-26	NP-7
	6-12	Fine sandy loam, sandy clay loam	SC, SM, CL, ML	A-6, A-4	0	0	100	98-100	90-100	36-65	15-37	NP-16
	12-32	Sandy clay loam, fine sandy loam	SC, SM, CL, ML	A-6, A-4	0	0	100	98-100	90-100	36-65	15-37	NP-16
	32-80	Fine sandy loam, sandy clay loam	SC, SM, CL, ML	A-4	0	0	100	98-100	90-100	36-60	15-30	NP-10
Devol-----------	0-14	Fine sandy loam	SC-SM, SM, CL-ML, ML	A-4, A-2	0	0	98-100	98-100	94-100	30-60	15-26	NP-7
	14-36	Fine sandy loam, loamy fine sand	SC-SM, SM, CL-ML, ML	A-4, A-2	0	0	98-100	98-100	90-100	15-60	0-26	NP-7
	36-72	Loamy fine sand, loamy sand, fine sand	SM, SC-SM	A-4, A-2	0	0	98-100	98-100	50-100	3-50	0-26	NP-7

Table 16.—Engineering Properties—Continued

Map unit symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 in	Fragments: 3-10 in	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
384758:												
Clairemont------	0-22	Silt loam	CL-ML, CL	A-6, A-4	0	0	100	98-100	85-100	60-90	20-35	4-17
	22-60	Silt loam, loam, silty clay loam	CL-ML, CL	A-6, A-4	0	0	100	98-100	95-100	65-95	20-40	4-20
384760:												
Eda-------------	0-11	Sand, loamy sand, fine sand, loamy fine sand	SP-SM, SM	A-3, A-2-4	0	0	100	100	75-81	7-13	0-22	NP-4
	11-35	Loamy sand, loamy fine sand, fine sand, sand	SM	A-2-4	0	0	100	100	75-82	26-33	0-21	NP-4
	35-80	Loamy sand, loamy fine sand, fine sand, sand	SM, SP-SM	A-3, A-2-4	0	0	100	100	91-98	9-16	0-21	NP-4
384762:												
Eda-------------	0-10	Loamy fine sand	SM	A-2	0	0	100	100	90-100	15-35	0-14	NP
	10-20	Loamy fine sand, loamy sand, sand	SP-SM, SM	A-3, A-2	0	0	100	100	82-98	3-35	0-14	NP
	20-80	Loamy fine sand, loamy sand, sand	SP-SM, SM	A-3, A-2	0	0	100	100	82-98	3-35	0-14	NP
384769:												
Quinlan---------	0-6	Loam	CL-ML, CL	A-6, A-4	0	0	100	100	90-100	51-97	22-35	6-14
	6-13	Silt loam, loam, clay loam	ML, SC, CL, CL-ML	A-7, A-6, A-4	0	0	100	100	90-100	36-98	0-43	NP-20
	13-20	Bedrock	---	---	---	---	---	---	---	---	---	---
Woodward--------	0-12	Loam	ML, CL-ML, CL	A-4	0	0	100	100	96-100	65-97	22-31	2-10
	12-24	Silt loam, loam, very fine sandy loam	ML, CL-ML, CL	A-4	0	0	100	100	94-100	51-97	15-31	NP-10
	24-40	Bedrock	---	---	---	---	---	---	---	---	---	---
384775:												
Devol-----------	0-14	Loamy fine sand	SM	A-2	0	0	98-100	98-100	90-100	15-35	0-14	NP
	14-36	Fine sandy loam, loamy fine sand	SC-SM, SM, CL-ML, ML	A-4, A-2	0	0	98-100	98-100	90-100	15-60	0-26	NP-7
	36-72	Loamy fine sand, loamy sand, fine sand	SM, SC-SM	A-4, A-2	0	0	98-100	98-100	50-100	3-50	0-26	NP-7
384776:												
Devol-----------	0-14	Loamy fine sand	SM	A-2	0	0	98-100	98-100	90-100	15-35	0-14	NP
	14-36	Fine sandy loam, loamy fine sand	SC-SM, SM, CL-ML, ML	A-4, A-2	0	0	98-100	98-100	90-100	15-60	0-26	NP-7
	36-72	Loamy fine sand, loamy sand, fine sand	SM, SC-SM	A-4, A-2	0	0	98-100	98-100	50-100	3-50	0-26	NP-7

Table 16.—Engineering Properties—Continued

Map unit symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 in	Fragments: 3-10 in	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
384777:												
Port------------	0-13	Silt loam	CL	A-6, A-4	0	0	100	100	96-100	65-97	27-37	8-14
	13-24	Silt loam, silty clay loam, loam, clay loam	CL	A-7, A-6, A-4	0	0	100	100	96-100	65-98	27-43	8-20
	24-80	Silt loam, loam, clay loam, silty clay loam	CL	A-7, A-6, A-4	0	0	100	100	96-100	65-98	27-43	8-20
384784:												
Woodward--------	0-12	Loam	ML, CL-ML, CL	A-4	0	0	100	100	96-100	65-97	22-31	2-10
	12-24	Silt loam, loam, very fine sandy loam	ML, CL-ML, CL	A-4	0	0	100	100	94-100	51-97	15-31	NP-10
	24-40	Bedrock	---	---	---	---	---	---	---	---	---	---
384785:												
Woodward--------	0-12	Loam	ML, CL-ML, CL	A-4	0	0	100	100	96-100	65-97	22-31	2-10
	12-24	Silt loam, loam, very fine sandy loam	ML, CL-ML, CL	A-4	0	0	100	100	94-100	51-97	15-31	NP-10
	24-40	Bedrock	---	---	---	---	---	---	---	---	---	---
384792:												
Westola---------	0-10	Fine sandy loam	SC-SM, SM, CL-ML, ML	A-4	0	0	100	95-100	90-100	36-60	15-26	NP-7
	10-40	Fine sandy loam, loam, very fine sandy loam	SC, SM, CL, ML	A-4	0	0	100	95-100	90-100	36-85	15-30	NP-10
	40-80	Stratified loam to loamy fine sand	SC, SM, CL, ML	A-4, A-2	0	0	100	95-100	90-100	15-85	15-30	NP-10
1605239:												
Canadian--------	0-15	Fine sandy loam	SC-SM, SM, CL-ML, ML	A-4	0	0	100	100	94-100	36-60	14-26	NP-7
	15-26	Fine sandy loam, loam, sandy loam	SC-SM, SM, CL-ML, ML	A-4	0	0	100	100	94-100	36-85	14-29	NP-7
	26-60	Fine sandy loam, loam, loamy fine sand	SC-SM, SM, CL-ML, ML	A-4, A-3, A-2	0	0	100	100	82-100	5-85	0-29	NP-7

Table 17.—Physical Soil Properties

(Absence of an entry indicates that data were not estimated. Soil properties are measured or inferred from direct observations in the field or laboratory)

Map unit symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Permeability (Ksat)	Available water capacity	Shrink-swell potential	Organic matter
	In	Pct	Pct	Pct	g/cc	In/hr	In/in	Pct	Pct
384742:									
Lincoln----------	0-12	43-85	0-50	10-18	1.30-1.60	6.0-20.0	0.10-0.15	0.0-2.9	0.5-1.0
	12-80	20-100	0-53	5-30	1.30-1.60	6.0-20.0	0.02-0.08	0.0-2.9	0.0-0.5
384751:									
Grandfield-------	0-6	43-85	0-50	10-18	1.30-1.60	2.0-6.0	0.11-0.15	0.0-2.9	0.5-1.0
	6-12	45-80	0-27	18-30	1.50-1.70	0.6-2.0	0.11-0.17	0.0-2.9	0.3-0.7
	12-32	45-80	0-27	18-30	1.50-1.70	0.6-2.0	0.11-0.17	0.0-2.9	0.3-0.7
	32-80	43-85	0-50	10-25	1.50-1.70	2.0-6.0	0.11-0.15	0.0-2.9	0.0-0.5
Nobscot----------	0-5	86-100	0-14	2-10	1.35-1.50	2.0-6.0	0.06-0.11	0.0-2.9	0.5-1.0
	5-34	70-100	0-30	2-10	1.35-1.50	2.0-6.0	0.05-0.11	0.0-2.9	0.5-1.0
	34-44	43-85	0-50	8-15	1.50-1.70	2.0-6.0	0.10-0.15	0.0-2.9	0.0-0.5
	44-54	70-100	0-30	2-12	1.60-1.70	2.0-6.0	0.05-0.11	0.0-2.9	0.0-0.5
	54-70	70-100	0-30	2-10	1.60-1.70	2.0-6.0	0.05-0.11	0.0-2.9	0.0-0.5
384753:									
Grandfield-------	0-6	43-85	0-50	10-18	1.30-1.60	2.0-6.0	0.11-0.15	0.0-2.9	0.5-1.0
	6-12	45-80	0-27	18-30	1.50-1.70	0.6-2.0	0.11-0.17	0.0-2.9	0.3-0.7
	12-32	45-80	0-27	18-30	1.50-1.70	0.6-2.0	0.11-0.17	0.0-2.9	0.3-0.7
	32-80	43-85	0-50	10-25	1.50-1.70	2.0-6.0	0.11-0.15	0.0-2.9	0.0-0.5
Devol------------	0-14	43-85	0-50	8-18	1.30-1.60	2.0-6.0	0.11-0.15	0.0-2.9	0.5-1.0
	14-36	43-90	0-50	2-18	1.50-1.70	2.0-6.0	0.07-0.15	0.0-2.9	0.0-0.5
	36-72	70-100	0-30	2-10	1.50-1.70	2.0-6.0	0.08-0.12	0.0-2.9	0.0-0.5
384758:									
Clairemont-------	0-22	0-50	50-88	15-27	1.40-1.60	0.6-2.0	0.16-0.22	0.0-2.9	0.5-2.0
	22-60	0-53	27-82	18-35	1.40-1.65	0.6-2.0	0.16-0.22	0.0-2.9	0.5-2.0
384760:									
Eda--------------	0-11	86-100	0-12	1-7	1.50-1.65	6.0-20.0	0.02-0.06	0.1-0.6	0.5-1.0
	11-35	70-100	0-29	1-8	1.50-1.75	6.0-20.0	0.02-0.11	0.1-0.7	0.0-0.5
	35-80	70-100	0-22	1-8	1.50-1.75	6.0-20.0	0.02-0.11	0.1-0.7	0.0-0.5
384762:									
Eda--------------	0-10	70-90	0-30	2-8	1.35-1.50	6.0-20.0	0.06-0.11	0.0-2.9	0.5-1.0
	10-20	70-100	0-30	1-8	1.50-1.70	6.0-20.0	0.02-0.11	0.0-2.9	0.0-0.5
	20-80	70-100	0-30	1-8	1.50-1.70	6.0-20.0	0.02-0.11	0.0-2.9	0.0-0.5

Table 17.—Physical Soil Properties—Continued

Map unit symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Permeability (Ksat)	Available water capacity	Shrink-swell potential	Organic matter
	In	Pct	Pct	Pct	g/cc	In/hr	In/in	Pct	Pct
384769:									
Quinlan----------	0-6	23-53	27-50	15-27	1.30-1.55	0.6-2.0	0.15-0.24	0.0-2.9	0.5-1.0
	6-13	0-53	15-88	10-30	1.30-1.70	0.6-6.0	0.07-0.22	0.0-2.9	0.5-1.0
	13-20	---	---	---	1.85-2.00	0.2-0.6	---	---	---
Woodward---------	0-12	32-52	27-50	10-18	1.30-1.60	0.6-2.0	0.15-0.24	0.0-2.9	0.5-2.0
	12-24	0-85	0-88	10-18	1.40-1.65	0.6-2.0	0.13-0.24	0.0-2.9	0.0-0.5
	24-40	---	---	---	1.85-2.00	0.2-0.6	---	---	---
384775:									
Devol------------	0-14	70-90	0-30	2-8	1.35-1.50	2.0-6.0	0.07-0.11	0.0-2.9	0.5-1.0
	14-36	43-90	0-50	2-18	1.50-1.70	2.0-6.0	0.07-0.15	0.0-2.9	0.0-0.5
	36-72	70-100	0-30	2-10	1.50-1.70	2.0-6.0	0.08-0.12	0.0-2.9	0.0-0.5
384776:									
Devol------------	0-14	70-90	0-30	2-8	1.35-1.50	2.0-6.0	0.07-0.11	0.0-2.9	0.5-1.0
	14-36	43-90	0-50	2-18	1.50-1.70	2.0-6.0	0.07-0.15	0.0-2.9	0.0-0.5
	36-72	70-100	0-30	2-10	1.50-1.70	2.0-6.0	0.08-0.12	0.0-2.9	0.0-0.5
384777:									
Port-------------	0-13	0-50	50-88	12-26	1.30-1.55	0.6-2.0	0.15-0.24	0.0-2.9	1.0-3.0
	13-24	0-53	15-82	20-35	1.30-1.60	0.6-2.0	0.15-0.24	3.0-5.9	0.0-1.0
	24-80	0-53	15-82	20-35	1.30-1.60	0.6-2.0	0.15-0.24	3.0-5.9	0.0-1.0
384784:									
Woodward---------	0-12	32-52	27-50	10-18	1.30-1.60	0.6-2.0	0.15-0.24	0.0-2.9	0.5-2.0
	12-24	0-85	0-88	10-18	1.40-1.65	0.6-2.0	0.13-0.24	0.0-2.9	0.0-0.5
	24-40	---	---	---	1.85-2.00	0.2-0.6	---	---	---
384785:									
Woodward---------	0-12	32-52	27-50	10-18	1.30-1.60	0.6-2.0	0.15-0.24	0.0-2.9	0.5-2.0
	12-24	0-85	0-88	10-18	1.40-1.65	0.6-2.0	0.13-0.24	0.0-2.9	0.0-0.5
	24-40	---	---	---	1.85-2.00	0.2-0.6	---	---	---
384792:									
Westola----------	0-10	43-85	0-50	10-18	1.30-1.60	2.0-6.0	0.11-0.15	0.0-2.9	0.5-1.0
	10-40	43-90	0-50	5-18	1.40-1.70	2.0-6.0	0.11-0.20	0.0-2.9	0.0-0.5
	40-80	32-90	0-50	5-18	1.40-1.70	2.0-6.0	0.07-0.20	0.0-2.9	0.0-0.5
1605239:									
Canadian---------	0-15	43-85	0-50	5-18	1.40-1.65	2.0-6.0	0.10-0.15	0.0-2.9	1.0-3.0
	15-26	32-85	0-50	10-18	1.35-1.70	2.0-6.0	0.10-0.20	0.0-2.9	0.0-2.0
	26-60	32-90	0-50	5-18	1.40-1.70	2.0-20.0	0.07-0.20	0.0-2.9	0.0-1.0

Table 18.—Erosion Properties

(Entries under "Erosion factors" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer)

Map unit symbol and soil name	Depth (inches)	Erosion factors			Wind erodibility group	Wind erodibility index
		Kw	Kf	T		
384742:						
Lincoln	0-12	.20	.20	5	3	86
	12-80	.17	.17			
384751:						
Grandfield	0-6	.24	.24	5	3	86
	6-12	.32	.32			
	12-32	.32	.32			
	32-80	.28	.28			
Nobscot	0-5	.17	.17	5	2	134
	5-34	.17	.17			
	34-44	.20	.20			
	44-54	.17	.17			
	54-70	.17	.17			
384753:						
Grandfield	0-6	.24	.24	5	3	86
	6-12	.32	.32			
	12-32	.32	.32			
	32-80	.28	.28			
Devol	0-14	.20	.20	5	3	86
	14-36	.20	.20			
	36-72	.17	.17			
384758:						
Clairemont	0-22	.43	.43	5	4L	86
	22-60	.43	.43			
384760:						
Eda	0-11	.02	.02	5	1	220
	11-35	.24	.24			
	35-80	.10	.10			
384762:						
Eda	0-10	.15	.15	5	2	134
	10-20	.15	.15			
	20-80	.15	.15			
384769:						
Quinlan	0-6	.37	.37	2	5	56
	6-13	.37	.37			
	13-20	---	---			
Woodward	0-12	.37	.37	3	5	56
	12-24	.37	.37			
	24-40	---	---			
384775:						
Devol	0-14	.17	.17	5	2	134
	14-36	.20	.20			
	36-72	.17	.17			
384776:						
Devol	0-14	.17	.17	5	2	134
	14-36	.20	.20			
	36-72	.17	.17			

Table 18.—Erosion Properties—Continued

Map unit symbol and soil name	Depth (inches)	Erosion factors Kw	Kf	T	Wind erodi- bility group	Wind erodi- bility index
384777:						
Port--------------------	0-13	.37	.37	5	5	56
	13-24	.37	.37			
	24-80	.37	.37			
384784:						
Woodward----------------	0-12	.37	.37	3	5	56
	12-24	.37	.37			
	24-40	---	---			
384785:						
Woodward----------------	0-12	.37	.37	3	5	56
	12-24	.37	.37			
	24-40	---	---			
384792:						
Westola-----------------	0-10	.20	.20	5	3	86
	10-40	.32	.32			
	40-80	.32	.32			
1605239:						
Canadian----------------	0-15	.20	.20	5	3	86
	15-26	.20	.20			
	26-60	.20	.20			

Table 19.—Soil Features

(See text for definitions of terms used in this table. Absence of an entry indicates that data were not estimated)

Map unit symbol and soil name	Restrictive layer			Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Hardness		Uncoated steel	Concrete
		In				
384742:						
Lincoln	No restriction	---	---	None	Low	Low
384751:						
Grandfield	No restriction	---	---	None	Low	Low
Nobscot	No restriction	---	---	None	Low	Moderate
384753:						
Grandfield	No restriction	---	---	None	Low	Low
Devol	No restriction	---	---	None	Low	Low
384758:						
Clairemont	No restriction	---	---	None	Moderate	Low
384760:						
Eda	No restriction	---	---	None	Low	Moderate
384762:						
Eda	No restriction	---	---	None	Low	Moderate
384769:						
Quinlan	Paralithic bedrock	10-20	Weakly cemented	None	Moderate	Low
Woodward	Paralithic bedrock	20-40	Weakly cemented	None	Low	Low
384775:						
Devol	No restriction	---	---	None	Low	Low
384776:						
Devol	No restriction	---	---	None	Low	Low
384777:						
Port	No restriction	---	---	None	Moderate	Low
384784:						
Woodward	Paralithic bedrock	20-40	Weakly cemented	None	Low	Low

Table 19.—Soil Features—Continued

Map unit symbol and soil name	Restrictive layer			Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Hardness		Uncoated steel	Concrete
		In				
384785:						
Woodward	Paralithic bedrock	20-40	Weakly cemented	None	Low	Low
384792:						
Westola	No restriction	---	---	None	Low	Low
1605239:						
Canadian	No restriction	---	---	None	Low	Low

Table 20.—Water Features

(See text for definitions of terms used in this table. Estimates of the frequency of ponding and flooding apply to the whole year rather than to individual months. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Map unit symbol and soil name	Hydrologic group	Months	Water table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
			Ft	Ft	Ft				
384742:									
Lincoln	A	Jan-Dec	---	---	---	---	None	Brief	Frequent
384751:									
Grandfield	B	Jan-Dec	---	---	---	---	None	---	None
Nobscot	A	Jan-Dec	---	---	---	---	None	---	None
384753:									
Grandfield	B	Jan-Dec	---	---	---	---	None	---	None
Devol	B	Jan-Dec	---	---	---	---	None	---	None
384758:									
Clairemont	B	Jan-Dec	---	---	---	---	None	Very brief	Occasional
384760:									
Eda	A	Jan-Dec	---	---	---	---	None	---	None
384762:									
Eda	A	Jan-Dec	---	---	---	---	None	---	None
384769:									
Quinlan	C	Jan-Dec	---	---	---	---	None	---	None
Woodward	B	Jan-Dec	---	---	---	---	None	---	None
384775:									
Devol	B	Jan-Dec	---	---	---	---	None	---	None

Table 20.—Water Features—Continued

Map unit symbol and soil name	Hydrologic group	Months	Water table: Upper limit	Water table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
			Ft	Ft	Ft				
384776:									
Devol	B								
		Jan-Dec	---	---	---	---	None	---	None
384777:									
Port	B								
		Jan-Dec	---	---	---	---	None	Brief	Occasional
384784:									
Woodward	B								
		Jan-Dec	---	---	---	---	None	---	None
384785:									
Woodward	B								
		Jan-Dec	---	---	---	---	None	---	None
384792:									
Westola	B								
		Jan-Dec	---	---	---	---	None	Very brief	Occasional
1605239:									
Canadian	B								
		Jan-Dec	---	---	---	---	None	Very brief	Rare

Table 21.—Total Soil Carbon

(This table displays soil organic carbon (SOC) and soil inorganic carbon (SIC) in kilograms per square meter to a depth of 2 meters or to the representative top depth of any kind of bedrock or any cemented soil horizon. SOC and SIC are reported on a volumetric whole soil basis, corrected for representative rock fragments indicated in the database. SOC is converted from horizon soil organic matter of the fraction of the soil less than 2 mm in diameter. If soil organic matter indicated in the database is NULL, SOC is assumed to be zero. SIC is converted from horizon calcium carbonate content fraction of the soil less than 2 mm in diameter. If horizon calcium carbonate indicated in the database is NULL, SIC is assumed to be zero. A weighted average of all horizons is used in the calculations. Only major components of a map unit are displayed in this table)

Map unit symbol, component name, and component percent	SOC	SIC
	kg/m^2	kg/m^2
384742:		
Lincoln (95%)	5	10
384751:		
Grandfield (70%)	7	7
Nobscot (20%)	7	0
384753:		
Grandfield (55%)	7	7
Devol (40%)	6	2
384758:		
Clairemont (95%)	17	17
384760:		
Eda (90%)	6	2
384762:		
Eda (90%)	6	3
384769:		
Quinlan (65%)	2	4
Woodward (30%)	4	8
384775:		
Devol (95%)	6	2
384776:		
Devol (90%)	6	2
384777:		
Port (90%)	12	1
384784:		
Woodward (90%)	4	8
384785:		
Woodward (95%)	4	8

Table 21.—Total Soil Carbon—Continued

Map unit symbol, component name, and component percent	SOC	SIC
	kg/m^2	kg/m^2
384792:		
Westola (90%)	5	21
1605239:		
Canadian (85%)	13	0

Table 22.—Chemical Soil Properties

(Absence of an entry indicates that data were not estimated)

Map unit symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Sodium adsorp-tion ratio
	In	meq/100 g	pH	Pct	Pct	
384742:						
Lincoln	0-12	7.0-12.0	7.4-8.4	0-5	0	0
	12-80	4.0-10.0	7.9-8.4	0-5	0	0
384751:						
Grandfield	0-6	9.0-14.0	6.1-7.8	0	0	0
	6-12	14.0-21.0	6.1-7.8	0	0	0
	12-32	14.0-21.0	6.6-8.4	0	0	0
	32-80	12.0-18.0	6.6-8.4	0-5	0	0
Nobscot	0-5	2.0-6.0	5.6-7.3	0	0	0
	5-34	2.0-6.0	5.6-7.3	0	0	0
	34-44	5.0-9.0	5.1-6.5	0	0	0
	44-54	2.0-7.0	5.1-6.5	0	0	0
	54-70	2.0-6.0	6.1-7.3	0	0	0
384753:						
Grandfield	0-6	9.0-14.0	6.1-7.8	0	0	0
	6-12	14.0-21.0	6.1-7.8	0	0	0
	12-32	14.0-21.0	6.6-8.4	0	0	0
	32-80	12.0-18.0	6.6-8.4	0-5	0	0
Devol	0-14	5.0-11.0	5.6-7.8	0	0	0
	14-36	2.0-11.0	6.1-8.4	0	0	0
	36-72	2.0-6.0	6.6-8.4	0-1	0	0
384758:						
Clairemont	0-22	10.0-20.0	7.9-8.4	1-5	0	0
	22-60	10.0-20.0	7.9-8.4	5-10	0-2	0-4
384760:						
Eda	0-11	1.0-5.7	5.6-7.3	0	0	0
	11-35	0.8-6.1	5.6-7.3	0	0	0
	35-80	0.8-6.1	6.1-7.3	0-2	0	0
384762:						
Eda	0-10	2.0-6.0	5.6-7.3	0	0	0
	10-20	1.0-6.0	5.6-7.3	0	0	0
	20-80	1.0-6.0	6.1-7.3	0-2	0	0
384769:						
Quinlan	0-6	10.0-17.0	7.4-8.4	0-10	0	0
	6-13	7.0-18.0	7.4-8.4	0-15	0-2	0
	13-20	---	---	---	---	---
Woodward	0-12	7.0-11.0	6.6-8.4	0-10	0	0
	12-24	7.0-11.0	7.4-8.4	2-15	0	0
	24-40	---	---	---	---	---
384775:						
Devol	0-14	2.0-8.0	5.6-7.8	0	0	0
	14-36	2.0-11.0	6.1-8.4	0	0	0
	36-72	2.0-6.0	6.6-8.4	0-1	0	0

Table 22.—Chemical Soil Properties—Continued

Map unit symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Sodium adsorp-tion ratio
	In	meq/100 g	pH	Pct	Pct	
384776:						
Devol	0-14	2.0-8.0	5.6-7.8	0	0	0
	14-36	2.0-11.0	6.1-8.4	0	0	0
	36-72	2.0-6.0	6.6-8.4	0-1	0	0
384777:						
Port	0-13	8.0-16.0	5.6-7.8	0-2	0	0
	13-24	12.0-21.0	6.1-8.4	0	0	0
	24-80	12.0-21.0	6.1-8.4	0	0	0
384784:						
Woodward	0-12	7.0-11.0	6.6-8.4	0-10	0	0
	12-24	7.0-11.0	7.4-8.4	2-15	0	0
	24-40	---	---	---	---	---
384785:						
Woodward	0-12	7.0-11.0	6.6-8.4	0-10	0	0
	12-24	7.0-11.0	7.4-8.4	2-15	0	0
	24-40	---	---	---	---	---
384792:						
Westola	0-10	7.0-11.0	7.4-8.4	1-5	0	0
	10-40	4.0-11.0	7.9-8.4	1-10	0	0
	40-80	4.0-11.0	7.9-8.4	1-10	0	0
1605239:						
Canadian	0-15	3.0-11.0	5.6-7.8	0	0	0
	15-26	6.0-11.0	6.1-8.4	0	0	0
	26-60	3.0-11.0	6.1-8.4	0	0	0

Table 23.—Taxonomic Classification of the Soils

Soil name	Family or higher taxonomic class
Canadian	Coarse-loamy, mixed, superactive, thermic Udic Haplustolls
Carey	Fine-silty, mixed, superactive, thermic Typic Argiustolls
Carwile	Fine, superactive, thermic Typic Argiaquolls
Clairemont	Fine-silty, mixed, superactive, calcareous, thermic Typic Ustifluvents
Cordell	Loamy, mixed, active, thermic Lithic Haplustepts
Delwin	Fine-loamy, active, thermic Typic Paleustalfs
Devol	Coarse-loamy, mixed, superactive, thermic Typic Haplustalfs
Dill	Coarse-loamy, mixed, active, thermic Typic Haplustepts
Eda	Mixed, thermic Lamellic Ustipsamments
Ezell	Sandy, mixed, thermic Aeric Fluvaquents
Grandfield	Fine-loamy, mixed, superactive, thermic Typic Haplustalfs
Hardeman	Coarse-loamy, mixed, superactive, thermic Typic Haplustepts
Heatly	Loamy, active, thermic Arenic Paleustalfs
Lincoln	Sandy, mixed, thermic Typic Ustifluvents
Nobscot	Loamy, mixed, superactive, thermic Arenic Paleustalfs
Port	Fine-silty, mixed, superactive, thermic Cumulic Haplustolls
Quinlan	Loamy, mixed, superactive, thermic, shallow Typic Haplustepts
Tivoli	Mixed, thermic Typic Ustipsamments
Westola	Coarse-loamy, mixed, superactive, calcareous, thermic Typic Ustifluvents
Woodward	Coarse-silty, mixed, superactive, thermic Typic Haplustepts

Table 24.—Soil Classification Key

Order	Suborder	Great Group	Subgroup	Series or Higher Category	
ALFISOLS					
	Ustalfs				
		Haplustalfs			
			Typic Haplustalfs		
				Devol	Coarse-loamy, mixed, superactive, thermic Typic Haplustalfs
				Grandfield	Fine-loamy, mixed, superactive, thermic Typic Haplustalfs
		Paleustalfs			
			Typic Paleustalfs		
				Delwin	Fine-loamy, active, thermic Typic Paleustalfs
			Arenic Paleustalfs		
				Heatly	Loamy, active, thermic Arenic Paleustalfs
				Nobscot	Loamy, mixed, superactive, thermic Arenic Paleustalfs
ENTISOLS					
	Aquents				
		Fluvaquents			
			Aeric Fluvaquents		
				Ezell	Sandy, mixed, thermic Aeric Fluvaquents
	Fluvents				
		Ustifluvents			
			Typic Ustifluvents		
				Westola	Coarse-loamy, mixed, superactive, calcareous, thermic Typic Ustifluvents
				Clairemont	Fine-silty, mixed, superactive, calcareous, thermic Typic Ustifluvents
				Lincoln	Sandy, mixed, thermic Typic Ustifluvents
	Psamments				
		Ustipsamments			
			Typic Ustipsamments		
				Tivoli	Mixed, thermic Typic Ustipsamments
			Lamellic Ustipsamments		
				Eda	Mixed, thermic Lamellic Ustipsamments
INCEPTISOLS					
	Ustepts				
		Haplustepts			
			Lithic Haplustepts		
				Cordell	Loamy, mixed, active, thermic Lithic Haplustepts
			Typic Haplustepts		
				Dill	Coarse-loamy, mixed, active, thermic Typic Haplustepts
				Hardeman	Coarse-loamy, mixed, superactive, thermic Typic Haplustepts
				Woodward	Coarse-silty, mixed, superactive, thermic Typic Haplustepts
				Quinlan	Loamy, mixed, superactive, thermic, shallow Typic Haplustepts
MOLLISOLS					
	Aquolls				
		Argiaquolls			
			Typic Argiaquolls		
				Carwile	Fine, superactive, thermic Typic Argiaquolls
	Ustolls				
		Argiustolls			
			Typic Argiustolls		
				Carey	Fine-silty, mixed, superactive, thermic Typic Argiustolls
		Haplustolls			
			Cumulic Haplustolls		
				Port	Fine-silty, mixed, superactive, thermic Cumulic Haplustolls
			Udic Haplustolls		
				Canadian	Coarse-loamy, mixed, superactive, thermic Udic Haplustolls

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