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Identification Legend

<u>Map symbol</u>	<u>Map unit name</u>
400	Canuela-Rock outcrop-Andanada-Kayefes complex, 3 to 12 percent slopes
401	Rock outcrop-Abrojo-Palatka complex, 25 to 65 percent slopes
402	Navajita sandy loam, 3 to 15 percent slopes
403	Piojillo gravelly loamy coarse sand, 3 to 15 percent slopes
404	Negrita-Levante coarse sands, 0 to 3 percent slopes
405	Estante-Potente complex, 3 to 50 percent slopes
406	Rock outcrop-Zacaton-Palatka complex, 25 to 60 percent slopes

Summary of Tables

Recreational development (table 1)

Wildlife habitat (table 2)

Building site development (table 3)

Sanitary facilities (table 4)

Construction materials (table 5)

Water management (table 6)

Engineering index properties (table 7)

Physical properties of the soils (table 8)

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Water features (table 10)

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Classification of the soils (table 12)

Foreword

This report contains information that can be used in land-planning programs in the Tsankawi part of Bandelier National Monument. It contains predictions of soil behavior for selected land uses. The report also highlights soil limitations, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This report is designed for many different users. Planners can use the report to plan land use, select sites for construction, and identify special practices needed to ensure proper performance.

Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the report to help them understand, protect, and enhance the environment.

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 that affect various land uses. The 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 subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads.

These and many other soil properties that affect land use are described in this report. The location of each soil is shown on the detailed soil maps. Each soil in the report is described. Information on specific uses is given for each soil. Help in using this publication and additional information is available at the Santa Fe Soil Survey Office of the Natural Resources Conservation Service.

Soil scientists have determined that there are about 12 different kinds of soils in the Tsankawi Area. The soils vary widely in their texture, color, natural drainage, slope, and other characteristics.

Descriptions, names, and delineation's of soils in this soil survey do not fully agree with those on soil maps for previous surveys. These differences are the result of different scales of mapping, intensity of mapping, better knowledge of soils, modifications in soil series concepts, or the extent of soils within the survey area.

General Nature of the Survey Area

This section gives general information concerning the Tsankawi Area. It briefly discusses the history and development; the physiography, geology, and geomorphology; and the climate of the survey area.

History and Development

Although Paleo-Indian and Archaic people nomadic wanderings may have occurred near the Tsankawi Area between 8,000 and 10,000 B.C., human occupation of the area by Keresans and Tewa-speaking people did not occur until the 800's A.D. By the 15th century, drought and soil depletion forced their migration to the nearby canyon floors of the Rio Grande.

The Spanish entered the Southwest in the mid-1500's and immediately encountered the Pueblo people.

Los Alamos, New Mexico is the closest community to the survey area, and has approximately 18,000 people.

Physiography, Geology, and Geomorphology

The Tsankawi Area lies within the Southern Rocky Mountains physiographic province on the Pajarito Plateau, which is composed of the Jemez Volcanic Pile flanking the east side of the Jemez mountains and continuing basically to the edge of the Rio Grande. This area is in the geologic formation of the Bandelier Tuff. Most of the map units are formed in the upper Tshirege Member, but the lower Otowi Member also contributes to the formation of some soils. The Pajarito Plateau is highly dissected by deep southeast trending canyons that have given the area distinct mesa/canyon topography. High stream terrace surfaces are greatly eroded, but do exist in small-localized areas. Geomorphic surfaces also include mesas and valley floors.

Climate

The climate of the Tsankawi Area is continental and so displays a large annual variation in temperature. The rugged topography in certain places produces some variation in the moisture climate zones of the survey area. These climate zones are all in the aridic ustic moisture regime, but appreciable differences occur between north and south facing slopes

Mean annual temperatures range from about 46 degrees F to 49 degrees F. The diurnal range of temperatures is quite large and may exceed 30 degrees F. Because of the relatively high elevations in the Tsankawi Area, winters are generally cold. The average number of days with freezing temperatures is about 130 days.

Mean annual precipitation ranges from 14 to 16 inches. Precipitation varies widely from month to month and year to year. The amounts of precipitation that are received exhibit a slight maximum in the summer with over one-third of the annual average falling in the months of July through September.

The primary source of moisture during the summer monsoon season is air from over the Gulf of Mexico. Southeast winds caused by the circulation patterns around the Bermuda high-pressure area shift westward in the summer. This brings moisture-laden tropical air into the southwestern United States. Occasionally, an influx of moisture from the eastern subtropical Pacific occurs in late summer as weakened storm systems from the Gulf of California disintegrate over Arizona and New Mexico. Most summer precipitation falls as heavy rain from brief, isolated, high-intensity convective thunderstorms which are usually accompanied by strong, gusty winds and occasionally drop hail. Flash flooding in normally dry washes is common during this time of the year.

During the winter, precipitation falls in a widespread pattern and is produced by Pacific Ocean storm fronts moving inland from the west. Winter precipitation is much heavier in the higher elevations, where the storm systems are lifted as they pass over the mountains and high plateaus.

Sunshine occurs on an annual average of 70 percent of the daylight hours. The sun shines 80 percent of the time in summer and 60 percent in winter. The average relative humidity in mid-afternoon is about 35 percent. Humidity is higher at night, and the average at dawn is about 65 percent. In late spring and early summer afternoons humidity drops as low as 15 to 20 percent.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the Tsankawi area. 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 pattern of drainage; the kinds of crops and 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 to the unconsolidated material or bedrock in which the soil formed. The unconsolidated material or bedrock is largely 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 are 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 soil map units. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landform relationships, are sufficient to verify predictions of the kinds of soil and map units in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, depth, size and shape of soil peds, kind and amount of rock fragments, distribution of plant roots, reaction, salinity, sodicity, 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 called series. 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. The analyses are performed at laboratories using proven analytical methods (USDA, 1991). Some simple tests are also performed by soil scientists in an office setting to gather additional data or to confirm laboratory data. 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 some 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. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are

predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot 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 drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately. The use of overlapping vertical aerial photographs and optical devices known as stereoscopes enabled the soil scientists to see landscapes and individual landforms in three dimensions. This technique is known as stereoscopy and is an essential tool for the accurate placement of soil delineation's (boundaries) in areas of medium to high relief. Different tonal patterns on aerial photographs are often related to distinct differences in soil, slope, vegetation, moisture, erosion, and geology. Tonal differences are additional tools used by soil scientists to make accurate soil maps on aerial photographs.

The descriptions, names, and delineation's of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in soil series concepts, variations in the intensity of mapping or in the extent of the soils in the survey areas, or differences in map unit design.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for

the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

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

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

investigation is needed to plan for intensive uses in small areas.

Detailed Soil Map Units

A map unit is a collection of areas defined and named the same in terms of their major kinds of soil or miscellaneous areas or both. Each map unit differs in some respect from all others in a survey area and is uniquely identified on a soil map. Each identified area on the map is a delineation. The map unit delineations on the detailed soil maps spatially represent the soils or miscellaneous areas in this survey area. The map unit descriptions in this section, along with the maps, 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. More information about each map unit is given under the heading "Use and Management of the Soils."

A map unit delineation represents an area dominated by one or more major kinds of soil or miscellaneous areas. These different kinds of soil or miscellaneous areas are considered components of the map unit. A map unit is identified and named according to the relative percentages of the dominant components. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas 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 "included" components that belong to other taxonomic classes or are different miscellaneous land types.

Most included soil components 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 not contrasting and are called similar soils. These similar soils are not named in the map unit descriptions. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of contrasting inclusions are identified by special symbols on the maps. The soils or miscellaneous areas considered contrasting inclusions are mentioned in the map unit descriptions. A contrasting inclusion 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 similar soils or contrasting inclusions 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, but if intensive use of small areas is planned, onsite investigation is needed to locate and define the soils and miscellaneous areas in more detail.

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. Soil phases were not used in this report, but some map units had only one major soil component. These map units are called consociations. An example of a consociation is Navajita sandy loam, 3 to 15 percent slopes.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or associations.

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 maps having a scale of 1 to 12,000. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Rock outcrop-Zacaton-Palatka complex, 25 to 60 percent slopes, is an example.

An association is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. We felt that in this project, any geographically associated soil could and should be separated as consociations.

This survey includes miscellaneous areas. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is the only miscellaneous area in this report, although there are inclusions of tuff talus in the 401 and 406 units.

Map unit Descriptions

400—Canuela-Rock Outcrop-Andanada-Kayefes complex, 3 to 12 percent slopes

Setting

Landform: Mestas

Position on the landform: **Canuela**—summits; **Rock outcrop**—exposed bedrock; **Andanada**—eroded summits; **Kayefes**—convex shaped summits

Subsurface geology: Colluvium over residuum derived from volcanic ash and pumice

Present vegetation: **Canuela**—blue grama, needleandthread grass, broom snakeweed, Wyoming big sagebrush, fringed sagewort, plains prickly pear, twoneedle pinyon, and oneseed juniper, **Andanada**—twoneedle pinyon, oneseed juniper, mountain mahogany, broom snakeweed, red threeawn, plains prickly pear, fringed sagewort, and blue grama; **Kayefes**—twoneedle pinyon, oneseed juniper, and mountain mahogany
Slope: **Canuela**—3 to 8 percent; **Andanada**—5 to 10 percent; **Kayefes**—6 to 12 percent

Shape of areas: Elongated

Size of areas: 20 to 100 acres

Elevation: 6,500 to 6,700 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 47 to 49 degrees F.

Frost-free period: 120 to 140 days

Composition

Canuela sandy loam and similar soils: 30 percent

Rock outcrop: 25 percent

Andanada gravelly sandy loam and similar soils: 20 percent

Kayefes sandy loam and similar soils: 15 percent

Contrasting inclusions: 10 percent

Contrasting Inclusions

- *The steeply sloping Palatka soil on backslopes
- *Soils that are moderately deep to bedrock on wider summit areas

Characteristics of the Canuela Soil

Typical profile:

- *0 to 2 inches--pale brown sandy loam
- *2 to 7 inches—brown loam
- *7 to 16 inches—light brown extremely paracobbly loam
- *16 inches—hard tuff bedrock

Parent material: Alluvium and residuum derived from volcanic ash and pumice

~~*Depth class:* Shallow~~

Drainage class: Well drained

Permeability: 0 to 2 inches—moderately rapid, 2 to 16 inches--moderate, 16 inches—very slow

Available water capacity: Low

Surface runoff: Moderate

~~*Hazard of water erosion:* Severe~~

~~*Hazard of soil blowing:* Moderate~~

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 2 inches--low, 2 to 7 inches—moderate, 7 to 16 inches—high, below 16 inches—very high

Characteristics of Rock outcrop

Rock outcrop consists of exposed tuff bedrock. It occurs as gently sloping bedrock and knobs intermingled with the Andanada and Kayefes soil.

Characteristics of the Andanada Soil

Typical profile:

- *0 to 2 inches--grayish brown gravelly sandy loam
- *2 to 5 inches-- grayish brown very gravelly sandy loam
- *5 to 9 inches—white soft tuff bedrock
- *9 inches—hard tuff bedrock

Parent material: Alluvium and residuum derived

from volcanic ash and pumice

~~*Depth class:* Very shallow~~

Drainage class: Well drained

Permeability: 0 to 5 inches--moderately rapid, 5 to 9 inches--rapid

Available water capacity: Low

Surface runoff: Moderate

~~*Hazard of water erosion:* Severe~~

~~*Hazard of soil blowing:* Moderate~~

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 2 inches--low, 2 to 80 inches--moderate

Characteristics of the Kayefes Soil

Typical profile:

- *0 to 2 inches--slightly decomposed needles, twigs, leaves and cones
- *2 to 4 inches—pale brown sandy loam
- *4 to 6 inches—pale brown sandy loam
- *6 to 8 inches—white extremely paracobbly sandy loam
- *8 to 11 inches—pale brown sandy loam
- *11 inches—hard tuff bedrock

Parent material: Alluvium and residuum derived from volcanic ash and pumice

~~*Depth class:* Shallow~~

Drainage class: Well drained

Permeability: 0 to 11 inches--moderately rapid

Available water capacity: Low

Surface runoff: Medium

~~*Hazard of water erosion:* Very severe~~

~~*Hazard of soil blowing:* Severe~~

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 6 inches--low, 6 to 8 inches—moderate, 8 to 11 inches--low

Major Uses

Recreation
Wildlife habitat

401—Rock Outcrop-Abrojo-Palatka complex, 25 to 65 percent slopes

Setting

Landform: South-facing backslopes of mesas

Position on the landform: **Rock outcrop**—steeply sloping bedrock; **Abrojo**—lower backslopes;

Palatka—upper backslopes

Subsurface geology: Rhyolitic volcanic ash, pumice, and breccias of the Bandelier Tuff formation

Present vegetation: **Abrojo**—oneseed juniper, twoneedle pinyon, blue grama, black grama, and broom snakeweed; **Palatka**-- twoneedle pinyon, oneseed juniper, mountain mahogany, blue grama, broom snakeweed, and fourwing saltbush

Slope: **Abrojo**—25 to 65 percent; **Palatka**—25 to 50 percent

Shape of areas: Elongated

Size of areas: 50 to 200 acres

Elevation: 6,400 to 6,700 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 48 to 50 degrees F.

Frost-free period: 120 to 140 days

Composition

Rock outcrop: 40 percent

Abrojo extremely cobbly loamy coarse sand and similar soils: 30 percent

Palatka sandy loam and similar soils: 20 percent

Contrasting inclusions: 10 percent

Contrasting Inclusions

*The shallow Canuela soil on small benches

*The coarse textured Piojillo soil on small fan remnants

*The shallow Kayefes under pinyon and juniper trees

*Small areas of talus (composed mostly of tuff fragments) on steep colluvial slopes

Characteristics of Rock outcrop

Rock outcrop consists of exposed ashflow tuff bedrock and breccia. It occurs as steeply sloping bedrock and vertical cliffs intermingled with the Palatka soil.

Characteristics of the Abrojo Soil

Typical profile:

*0 to 2 inches--light brown extremely cobbly loamy coarse sand

*3 to 23 inches--pink very gravelly loamy coarse sand

*23 to 30 inches--pink gravelly loamy coarse sand

*30 to 64 inches--white sandy loam

*64 to 80 inches--reddish yellow gravelly loamy coarse sand

Parent material: Colluvium and residuum derived from volcanic ash and pumice

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: 0 to 30 inches--rapid, 30 to 64 inches--moderately rapid, 64 to 80--rapid

Available water capacity: Low

Surface runoff: Moderate

Hazard of water erosion: Severe

Hazard of soil blowing: Moderate

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 2 inches--low, 2 to 80 inches--moderate

Characteristics of the Palatka Soil

Typical profile:

*0 to 1 inches—slightly decomposed needles, twigs, leaves and cones

*1 to 5 inches—grayish brown sandy loam

*5 to 7 inches—dark grayish brown gravelly sandy loam

*7 to 11 inches—soft tuff bedrock

*11 inches—hard tuff bedrock

Parent material: Eolian material and alluvium derived from volcanic ash, tuff, and pumice

Depth class: Very shallow

Drainage class: Well drained

Permeability: 0 to 7 inches--moderately rapid

Available water capacity: Very low

Surface runoff: Rapid

Hazard of water erosion: Severe

Hazard of soil blowing: None

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 7 inches--low, 7 to 11 inches--moderate, below 11 inches--extremely high

Major Uses

Recreation

Wildlife habitat

602--Navajita sandy loam, 3 to 15 percent slopes

Setting

Landform: Fan remnants

Position on the landform: North-facing treads

Subsurface geology: Rhyolitic volcanic ash, pumice, and breccias of the Bandelier Tuff formation

Present vegetation: Ponderosa pine, twoneedle pinyon, oneseed juniper, mountain mahogany, little bluestem, threeawn, and pingue

Shape of areas: Irregular

Size of areas: 10 to 100 acres

Elevation: 6,400 to 6,600 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 47 to 49 degrees F.

Frost-free period: 120 to 140 days

Composition

Navajita soil and similar soils: 90 percent

Contrasting inclusions: 10 percent

Contrasting Inclusions

*The coarse textured Piojillo soil on treads

*The steeply sloping Zacaton soil on north-facing backslopes

*Coarse textured soils on north-facing treads

*Andanada like soils that are very shallow or shallow to basalt bedrock in the northeast part of survey area

*The rarely flooded Negrita soil on low stream terraces

*The frequently flooded Levante soil on flood plains

Typical Profile

*0 to 3 inches--brown sandy loam

*3 to 25 inches--yellowish brown sandy loam

*25 to 38 inches--brown sandy loam

*38 to 51 inches--pale brown sandy loam

*51 to 62 inches--brown sandy clay loam

*62 to 81 inches--light brown sandy clay loam

Soil Properties and Qualities

Parent material: Eolian material and alluvium derived from volcanic ash and tuff

Depth class: Very deep

Drainage class: Well drained

Permeability: 0 to 51 inches--moderately rapid, 51 to 81 inches--moderate

Available water capacity: Low to moderate

Surface runoff: Medium

Hazard of water erosion: Moderate

Hazard of soil blowing: Moderate

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 3 inches--low, 3 to 81 inches--moderate

Major Uses

Recreation

Wildlife habitat

103—Piojillo gravelly loamy coarse sand, 3 to 15 percent slopes

Setting

Sandform: Fan remnants

Position on the landform: South-facing treads

Subsurface geology: Rhyolitic volcanic ash, pumice, and breccias of the Bandelier Tuff formation

Present vegetation: Oneseed juniper, twoneedle pinyon, blue grama, little bluestem, threeawn, and buckwheat

Shape of areas: Irregular

Size of areas: 20 to 100 acres

Elevation: 6,400 to 6,600 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 48 to 50 degrees F.

Frost-free period: 120 to 140 days

Composition

Piojillo gravelly loamy coarse sand and similar soils:
90 percent

Contrasting inclusions: 10 percent

Contrasting Inclusions

*The moderately coarse textured Navajita soil on north-facing fan remnants

*The steeply sloping Abrojo soil on south-facing backslopes

*The rarely flooded Negrita soil on low stream terraces

*The frequently flooded Levante soil on flood plains

Typical profile

*0 to 6 inches—pale brown gravelly loamy coarse sand

*6 to 21 inches—pale brown loamy coarse sand

*21 to 35 inches—pale brown loamy coarse sand

*35 to 110 inches—very pale brown gravelly loamy coarse sand

Soil Properties and Qualities

Parent material: Alluvium derived from pumice and volcanic ash

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: 0 to 110 inches—rapid

Available water capacity: Low to moderate

Surface runoff: Very low

Hazard of water erosion: Moderate

Hazard of soil blowing: Moderate

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 110 inches—low

Major Uses

Recreation

Wildlife habitat

104—Negrita-Levante coarse sands, 0 to 3 percent slopes

Setting

Sandform: Valley floors

Position on the landform: **Negrita**—low stream terraces; **Levante**—flood plains

Subsurface geology: Rhyolitic volcanic ash, pumice, and breccias of the Bandelier Tuff formation

Present vegetation: **Negrita**—oneseed juniper, twoneedle pinyon, ponderosa pine, mountain mahogany, blue grama, and threeawn; **Levante**—oneseed juniper, mountain mahogany, mullein, blue grama, cheatgrass, rubber rabbitbrush, and scattered ponderosa pine

Slope: **Negrita**—1 to 3 percent slopes; **Levante**—0 to 2 percent slopes

Shape of areas: Long and narrow

Size of areas: 5 to 50 acres

Elevation: 6,400 to 6,600 feet

Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 49 degrees F.
Frost-free period: 120 to 140 days

Composition

Negrita soil and similar soils: 70 percent
Levante soil and similar soils: 20 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

- *The moderately coarse textured Navajita soil on north-facing fan remnants
- *The coarse textured Piojillo soil on south-facing fan remnants
- *Sandy Riverwash on frequently flooded narrow arroyos
- *Negrita like soils that are moderately coarse textured on low stream terraces

Characteristics of the Negrita Soil

Typical profile:

- *0 to 2 inches—grayish brown coarse sand
- *2 to 12 inches—dark grayish brown coarse sand
- *12 to 58 inches—grayish brown coarse sand
- *58 to 82 inches—brown coarse sand

Parent material: Alluvium derived from volcanic ash, pumice, and breccia

Depth class: Very deep

Drainage class: Excessively drained

Permeability: 0 to 82 inches--very rapid

Available water capacity: Very low

Surface runoff: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 82 inches--low

Characteristics of the Levante Soil

Typical profile:

- *0 to 2 inches—brown coarse sand
- *2 to 16 inches—grayish brown coarse sand
- *16 to 85 inches—grayish brown, brown, and pale brown coarse sand and gravelly coarse sand

Parent material: Alluvium derived from pumice and breccia

Depth class: Very deep

Drainage class: Excessively drained

Permeability: 0 to 85 inches—very rapid

Available water capacity: Very low

Surface runoff: Low

Hazard of water erosion: Slight

Hazard of soil blowing: Severe

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 85 inches—low

Major Uses

Recreation
Wildlife habitat

405—Estante-Potente complex, 3 to 60 percent slopes

Setting

Landform: High stream terraces

Position on the landform: **Estante**—risers;

Potente—treads

Subsurface geology: Rhyolitic volcanic ash, pumice, and breccias of the Bandelier Tuff formation

Present vegetation: **Estante**-- twoneedle pinyon, oneseed juniper, Gambel oak, blue grama, threeawn, and mountain mahogany; **Potente**—two needle pinyon, oneseed juniper, mountain mahogany, blue grama, broom snakeweed, threeawn, Wyoming big sagebrush, and Gambel oak

Slope: **Estante**—25 to 60 percent slopes;

Potente—3 to 15 percent slopes

Shape of areas: Irregular to elongated
Size of areas: 20 to 200 acres
Elevation: 6,400 to 6,500 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 49 degrees F.
Frost-free period: 120 to 140 days

Composition

Estante extremely cobbly coarse sandy loam and similar soils: 50 percent
Potente gravelly loam and similar soils: 40 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

- *The moderately coarse textured Navajita soil on north-facing fan remnants
- *The coarse textured Negrita soil on low stream terraces
- *The frequently flooded Levante soil on flood plains
- *Sandy Riverwash on frequently flooded narrow arroyos

Characteristics of the Estante Soil

Typical profile:

- *0 to 3 inches—brown extremely cobbly coarse sandy loam
- *3 to 11 inches—brown and light reddish brown very gravelly sandy clay loam
- *11 to 16 inches—reddish brown very gravelly coarse sandy loam
- *16 to 44 inches—light brown loam
- *44 to 60 inches—light yellowish brown loam

Parent material: Alluvium derived from basalt and rhyolite over residuum derived from volcanic ash and pumice

~~*Depth class:* Very deep~~

Drainage class: Well drained

Permeability: 0 to 3 inches--moderately rapid, 3 to 11 inches—moderate, 11 to 16 inches—moderately

rapid, 16 to 44 inches—moderate, 44 to 60 inches—moderately rapid

Available water capacity: Very low

Surface runoff: Medium

~~*Hazard of water erosion:* Moderate~~

~~*Hazard of soil blowing:* Slight~~

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 3 inches--moderate, 3 to 16 inches--high, 16 to 60 inches--moderate

Characteristics of the Potente Soil

Typical profile:

- *0 to 3 inches—brown gravelly loam
- *3 to 6 inches—reddish brown clay loam
- *6 to 9 inches—reddish brown clay loam
- *9 to 13 inches—pink gravelly loam
- *13 to 17 inches—pink gravelly sandy loam
- *17 to 22 inches—pinkish white very gravelly loamy coarse sand
- *22 to 26 inches—white very gravelly coarse sand
- *26 to 34 inches—petrocalcic horizon

Parent material: Alluvium derived from basalt and rhyolite

~~*Depth class:* Moderately deep~~

Drainage class: Well drained

Permeability: 0 to 3 inches--moderately rapid, 3 to 6 inches—slow, 6 to 9 inches—moderately slow, 9 to 17 inches—moderately rapid, 17 to 26 inches—very rapid, 26 to 34 inches—very slow

Available water capacity: Very low

Surface runoff: Medium

~~*Hazard of water erosion:* Moderate~~

~~*Hazard of soil blowing:* Slight~~

Corrosion potential: Steel--high, concrete--low

Excavation difficulty classes: 0 to 3 inches--low, 3 to 22 inches--high, 22 to 26 inches—very high, 26 to 34 inches—extremely high

Major Uses

Recreation
Wildlife habitat

406—Rock Outcrop-Zacaton-Palatka complex,
25 to 60 percent slopes

Setting

~~Landform:~~ North-facing backslopes of mesas

Position on the landform: **Rock outcrop**—steeply sloping bedrock and cliffs; **Zacaton**—lower backslopes; **Palatka**—upper backslopes

Subsurface geology: Rhyolitic volcanic ash, pumice, and breccias of the Bandelier Tuff formation

Present vegetation: **Zacaton**--twoneedle pinyon, oneseed juniper, mountain muhly and scattered ponderosa pine; **Palatka**—two needle pinyon, ponderosa pine, mountain mahogany, Gambel oak, mountain muhly, Indian ricegrass, and blue grama

Slope: **Zacaton**—25 to 50 percent slopes;

Palatka—35 to 60 percent slopes

Shape of areas: Irregular to elongated

Size of areas: 20 to 200 acres

Elevation: 6,400 to 6,700 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 46 to 48 degrees F

Frost-free period: 110 to 130 days

Composition

Rock outcrop: 40 percent

Zacaton very cobbly sandy loam and similar soils: 30 percent

Palatka sandy loam and similar soils: 25 percent

Contrasting inclusions: 5 percent

Contrasting Inclusions

*The moderately coarse textured Navajita soil on north-facing fan remnants

*The shallow Canuela soil on small benches

*Coarse textured soils on backslopes

*Small areas of talus (composed mostly of tuff fragments) on steep colluvial slopes

Characteristics of Rock outcrop

Rock outcrop consists of exposed tuff bedrock. It occurs as gently sloping bedrock and knobs intermingled with the Palatka soil.

Characteristics of the Zacaton Soil

Typical profile:

*0 to 1 inch—slightly decomposed twigs, needles, and cones

*1 to 3 inches—grayish brown very cobbly sandy loam

*3 to 18 inches—pale brown cobbly or gravelly sandy loam

*18 to 32 inches—white very cobbly loam

*32 to 63 inches—very pale brown gravelly sandy loam

*63 to 102 inches—pink gravelly loamy coarse sand

Parent material: Colluvium over residuum derived from pumice and volcanic ash

~~Depth class:~~ Very deep

Drainage class: Well drained

Permeability: 0 to 18 inches--moderately rapid, 18 to 32 inches—moderate, 32 to 63 inches—moderately rapid, 63 to 102 inches--rapid

Available water capacity: Moderate

Surface runoff: Rapid

~~Hazard of water erosion:~~ Severe

~~Hazard of soil blowing:~~ Moderate

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 1 to 32 inches--low, 32 to 48 inches--high, 48 to 102 inches--moderate

Characteristics of the Palatka Soil

Typical profile:

*0 to 1 inch—needles, twigs, leaves and cones

- *1 to 2 inches—grayish brown sandy loam
- *2 to 5 inches—grayish brown sandy loam
- *5 to 7 inches—dark grayish brown gravelly sandy loam
- *7 to 11 inches—soft tuff bedrock
- *11 inches—hard tuff bedrock

Parent material: Eolian material and alluvium derived from volcanic ash, tuff, and pumice

Depth class: Very shallow

Drainage class: Well drained

Permeability: 0 to 7 inches--moderately rapid

Available water capacity: Very low

Surface runoff: Rapid

Hazard of water erosion: Severe

Hazard of soil blowing: None

Corrosion potential: Steel--moderate, concrete--low

Excavation difficulty classes: 0 to 7 inches--low, 7 to 11 inches—moderate, below 11 inches—extremely high

Major Uses

Recreation

Wildlife habitat

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, vegetation, 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 as sites for buildings, sanitary facilities, highways and other transportation systems, for parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties. The potentials and limitations of each soil and miscellaneous land type are presented in the tables of this publication. The information in these tables was generated using the approved national standards of soil interpretation rating guides (USDA-NRCS, National Soil Survey Handbook).

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.

Recreation

Tsankawi Area is a place of scenic, geologic, and historic interest. These areas are used for camping, hiking, sightseeing, picnicking, nature study, and photography.

The soils of the survey area are rated in table 1 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 1, the degree of soil limitation is expressed as slight, moderate, or severe. Slight means that soil properties are generally favorable and that limitations are minor and easily overcome. Moderate means that limitations can be overcome or alleviated by planning, design, or special maintenance. Severe means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 1 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 4 and interpretations for dwellings without basements and for local roads and streets in table 3.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are moderately deep to very deep, have gentle slopes, are not wet, and are not subject to flooding during the period of use. The

surface has few or no stones or boulders, absorbs rainfall readily but remains firm, does not have fragile cryptogam crusts, and is not dusty when dry. Steep slopes and stones or boulders can greatly increase the cost of constructing campsites.

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

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

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

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are deep or very deep, firm when wet, are not dusty when dry, and are not subject to flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The best soils are also low in salt, sodium, and lime and are not droughty. The suitability of the

soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

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

In table 2, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

Rock outcrops furnish wildlife habitat when they occur as cliffs below rims of mesas and canyons. Although little or no vegetation grows on rock outcrops, they are still important to many species. Eagles, hawks, turkey vultures, owls, and swallows nest on cliffs and ledges. Migratory bats seasonally roost in cracks and caves. Foxes, bobcats, bears, and cougars have dens in alcoves and caves.

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

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

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affects the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, brome grass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affects the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Coniferous plants furnish browse and seeds. Soil properties and features that affects the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, Douglas fir, twoneedle pinyon and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. ~~Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture.~~ Examples of shrubs are mountain mahogany, antelope bitterbrush, Utah snowberry, and Wyoming big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

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

Engineering

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

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

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

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

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the 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, roadfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by

comparing the performance of existing similar structures on the same or similar soils.

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

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

Building Site Development

Table 3 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered slight if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; moderate if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and severe if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

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.

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.

Lawns and landscaping require soils on which turf and ornamental 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.

Sanitary Facilities

Table 4 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered slight if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; moderate if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and severe if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 4 also shows the suitability of the soils for use as daily cover for landfill. A rating of good indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; fair indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and poor indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base

of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

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

Table 4 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench

landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. This risk is low in the dry soils of arid and semiarid regions. Ease of excavation and revegetation should be considered.

The ratings in table 4 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best

workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 5 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated good, fair, or poor as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been

compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated good contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated fair are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, many stones, or 10 to 15 percent gypsum. Depth to the water table is 1 to 3 feet. Soils rated poor have a plasticity index of more than 10, a high shrink-swell potential, many stones, slopes of more than 25 percent, or more than 15 percent gypsum. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 5, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an

improbable source. Detached fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel because their resistance to slaking or rupture is too low. Sand does not slake to finer (silt or clay) particles and gravel has strong resistance to rupture.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated good have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts and sodium, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated fair are sandy soils, loamy soils that have a relatively high content of clay; soils that have only 20 to 40 inches of suitable material; soils that have an appreciable amount of gravel, cobbles, stones, boulders, soluble salts or sodium; or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated poor are very sandy or clayey; have less than 20 inches of suitable material; have a large amount of gravel, cobbles, stones, boulders, soluble salts or sodium; have slopes of more than 15 percent; or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 6 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 limitations are considered slight if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; moderate if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and severe if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers

will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, soluble salts, sodium, or gypsum. 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, permeability 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.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil

after drainage is adversely affected by extreme acidity or by problematic substances in the root zone like salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of soluble salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

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

estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

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

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 7 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area (Portland Cement Association, 1973). Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated in inches. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture (USDA, 1993). These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (American Society for Testing and Materials, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

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 oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

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

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical Properties

Table 8 shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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. Sand percentages are not given in this manuscript, but can be inferred from the sieve data in the engineering table.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. Silt percentages are not given in this manuscript, but can be inferred from the sieve data in the engineering table.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In table 8, 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, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 or 1/10 bar (33kPa or 10kPa) 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 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 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.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the w-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. Volume change is influenced by the amount and type of clay minerals in the soil.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 8, 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 factors are shown in table 8 as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of several 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 permeability. 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.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is the soil loss tolerance. It is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting the quality of the soil as a medium for plant growth 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 soil blowing in cultivated or bare disturbed areas. There is a close correlation between soil blowing and the size and durability of surface clodiness, rock fragments, organic matter, and the calcareous reaction. The soil properties that are most important with respect to soil blowing are soil texture, organic matter content, calcium carbonate reaction (effervescence), rock fragment content, and aggregate stability. Soils are placed into wind erodibility groups on the basis of the properties of the surface layer. The term "calcareous" means the fine-earth fraction of the surface layer has a strongly or violently effervescent reaction to cold, dilute hydrochloric acid. The soils assigned to group 1 are the most susceptible to soil blowing, and those assigned to group 8 are the least susceptible. The groups are as follows:

1.##Coarse sands, sands, fine sands, and very fine sands.

2.##Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.

3.##Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L.##Calcareous loams, silt loams, clay loams, and silty clay loams. Calcareous sandy clay loams are also assigned to this group in this survey area.

4.##Clays, silty clays, noncalcareous clay loams, and noncalcareous silty clay loams that are more than 35 percent clay.

5.##Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6.##Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7.##Sils, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

8.##Soils that are not subject to soil blowing because of greater than 60 percent rock fragments in or on the surface or because of surface wetness.

Wind erodibility index (I), used in the Wind Erosion Equation (WEQ), is assigned using the wind erodibility groups. The wind erodibility index values are assigned because of the difficulty in directly measuring them in the field. Wind erodibility index is used in calculations to determine prime farmland soils and highly erodible soil map units (55). In this survey it is used to assign hazard of soil blowing to components of detailed soil map units. The index values are assigned to soil surface layers as follows:

- 310. Very fine sand surfaces in wind erodibility group 1
- 250. Fine sand surfaces in wind erodibility group 1
- 220. Sand surfaces in wind erodibility group 1
- 180. Coarse sand or sand surfaces in wind erodibility group 1
- 160. Coarse sand surfaces in wind erodibility group 1
- 134. Surfaces in wind erodibility group 2
- 86. Surfaces in wind erodibility group 3
- 86. Surfaces in wind erodibility group 4L
- 86. Surfaces in wind erodibility group 4
- 56. Surfaces in wind erodibility group 5
- 48. Surfaces in wind erodibility group 6

- 38. Surfaces in wind erodibility group 7
- 0. Surfaces in wind erodibility group 8

The following rules are used to determine wind erodibility index values for surface layers with significant amounts of rock fragments: If percent of rock fragments by volume is between 15 and 35 percent, the index value is reduced by one wind erodibility group with a lower "I" value (e.g. a gravelly loamy sand is reduced from 134 to 86). If percent of rock fragments by volume is between 35 and 60, the index value is reduced by two wind erodibility groups with a lower "I" value (e.g. a very gravelly fine sandy loam is reduced from 86 to 48). If percent of rock fragments by volume is greater than 60, an "I" value of 0 is assigned for wind erodibility group 8.

Chemical Properties

Table 9 shows estimates of some chemical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. 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 amount of exchangeable cations that a soil can adsorb at pH 7.0. Cation-exchange capacity is a measure of the ability of a soil layer to retain cations, some of which are plant nutrients. Soils that have a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils that have a high cation-exchange capacity. Soils that have high cation-exchange capacity have the potential to retain nutrient cations and some pesticide compounds in upper layers, which reduces the risk of pollution of ground water. Cation-exchange capacity is expressed in milliequivalents per 100 grams (meq/100g) of soil.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Calcium carbonate equivalent is the quantity of carbonate in the soil expressed as calcium carbonate and as a weight percentage of the less than 2 millimeter fraction.

Availability of plant nutrients is influenced by the amount of carbonates in the soil. This is a result of the effect that carbonates have on soil pH and of the direct effect that carbonates have on nutrient availability. Nitrogen fertilizers should be incorporated into calcareous soils to prevent nitrite accumulation or ammonium-nitrogen volatilization. The availability of phosphorous and molybdenum to plant roots is reduced by the high levels of calcium and magnesium which are associated with carbonates. In addition, iron, boron, zinc, and manganese deficiencies are common in some plants growing in soils that have a high calcium carbonate equivalent. In dry climates, soils surfaces high in calcium carbonate are more subject to blowing during periods of prolonged, strong winds. This effect may occur in soils that have calcium carbonate equivalent of more than 5 percent.

Gypsum is the percent, by weight, of hydrated calcium sulfates in the fraction of the soil material that is less than 20 millimeters in diameter. Gypsum is partially soluble in water and can be dissolved and removed by water. Soils high in gypsum such as those with more than 10 percent gypsum, may collapse if the gypsum is removed by percolating water. Gypsum is corrosive to concrete. Corrosion of concrete is most likely to occur in soils that are more than about 1 percent gypsum, when periodic wetting and drying occurs.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of non-irrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio is a measure of the amount of sodium relative to calcium and magnesium in the water extract from saturated soil paste. It is the ratio of the sodium concentration divided by the square root of one-half of the calcium plus magnesium concentration. Concentrations are in milliequivalents per liter. Soils that have values for sodium adsorption ratio of 13 or more may have increased dispersion of organic matter and clay particles, reduced permeability and aeration, and a general degradation of soil structure. These deleterious effects may be evident in some soils when values for sodium adsorption ratio are as low as 4 or 5 and the soils are irrigated with high-quality, low-salt water (Shainberg, et al., 1981). Such soils do not have enough calcium carbonate or soluble salts to maintain clay particles in a non-dispersed (flocculated) state.

Water Features

Table 10 gives estimates of various 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.

The months in the table indicate the portion of the year in which the feature is most likely to be a concern.

Water table refers to a saturated zone in the soil. Table 10 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 indicating reduced iron and/or wetness 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. Table 10 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 covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by a combination of both sources. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in 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, rare, occasional, frequent, and very frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year or nearly 1 to 5 times in 100 years); occasional that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to

50 percent in any year or 5 to 50 times in 100 years); frequent that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year or more than 50 times in 100 years).

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.

Soil Features

Table 11 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 and thickness of the restrictive layer, both of which significantly affect the ease of excavation. Depth to top is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years.

Subsidence is not a problem in this survey area, so entries are not given.

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, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage 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, electrical resistivity near field capacity, and electrical conductivity of the saturation extract(salinity).

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.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1981 and USDA, 1993). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 12 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. Four of the orders occur in the Tsankawi Area. 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. Alfisols, Entisols, Inceptisols, and Mollisols occur in this survey area.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order.

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. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil.

SUBGROUP. Each great group has a typical subgroup. Other subgroups are intergrades or

extragrades. The typical subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties.

SERIES. 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.

Soil Series and their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975) and in "Keys to Soil Taxonomy" (USDA, 1998). Unless otherwise indicated, matrix colors in the descriptions are for dry soil. Moist colors are

described for soils which have drainage classes ranging from poorly to very poorly drained. Following the pedon description is the range of important characteristics of the soils in the series.

Locations of typical pedons are described in notation of both the U.S. Public Land Survey and the Geographic Coordinate System.

For the Geographic Coordinate System (latitude and longitude), all point locations are here referenced to the National Geodetic horizontal control network established by the North American datum of 1927.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Soil Descriptions

Abrojo Series

Classification: Sandy, mixed, mesic Aridic Ustorthents

Depth class: Very deep

Drainage class: Well drained

Permeability: 0 to 30 inches—rapid, 30 to 64 inches—moderately rapid, 64 inches--rapid

Landform: South-facing backslopes of mesas

Parent material: Colluvium and over residuum derived from volcanic ash and pumice

Slope range: 25 to 65 percent

Elevation: 6,490 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 48 to 50 degrees F.

Frost-free period: 120 to 140 days

Typical Pedon

Abrojo extremely cobbly loamy coarse sand—on south-facing backslopes of mesas sloping 50 percent to the south at 6,490 feet elevation--rangeland. Santa Fe County, New Mexico; about 2 miles north northwest of White Rock; 500 feet west and 1500

feet north of the southwest corner section 20, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 35 seconds North and Longitude 106 degrees 12 minutes 55 seconds West, NAD 297. (Colors are for dry soil unless otherwise noted.)

A--0 to 2 inches; light brown (7.5YR 6/3) extremely cobbly loamy coarse sand, brown (7.5YR 4/3) moist; weak medium platy structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; common fine and many very fine roots; common very fine irregularly shaped pores; 30 percent pebbles, 25 percent cobbles, 10 percent stones and 15 percent boulders; neutral (7.2); abrupt smooth boundary.

C1--2 to 9 inches; pink (7.5YR 7/3) very gravelly loamy coarse sand, brown (7.5YR 5/3) moist; single grained structure; loose, loose, nonsticky and nonplastic; few medium, common fine, and many very fine roots; common very fine irregularly shaped pores; 30 percent pebbles and 10 percent cobbles; slightly alkaline (pH 7.4); clear smooth boundary.

C2--9 to 23 inches; pink (7.5YR 7/3) very gravelly loamy coarse sand, brown (7.5YR 5/3) moist; single grained structure; loose, loose, nonsticky and nonplastic; few coarse, common medium, common fine, and common very fine roots; 25 percent pebbles, 10 percent cobbles, and 5 percent stones; moderately alkaline (pH 8.2); clear smooth boundary.

C3--23 to 30 inches; pink (7.5YR 7/3) gravelly loamy coarse sand, brown (7.5YR 5/3) moist; single grained structure; loose, loose, nonsticky and nonplastic; few very coarse, few coarse, few medium, common fine, and common very fine roots; 10 percent pebbles and 5 percent cobbles; moderately alkaline (pH 8.0); abrupt wavy boundary.

2C4--30 to 64 inches; white (7.5YR 8/1) sandy loam, light gray (7.5YR 7/1) moist, massive structure; soft, very friable, slightly sticky and nonplastic; few medium and few fine; few fine and few very fine tubular pores; slightly alkaline (pH 7.4); abrupt wavy boundary.

3C5--64 to 80 inches; reddish yellow (7.5YR 7/6) gravelly loamy coarse sand, strong brown (7.5YR 5/6) moist; single grained structure; loose, loose, nonsticky and nonplastic; 25 percent pebbles; slightly alkaline (pH 7.6).

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 49 to 51 degrees F.

Particle-size control section weighted averages:

Silicate clay content: 10 to 18 percent; Sand content: 30 to 70 percent; Fine sand or coarser content: 35 to 60 percent; Rock fragment content: 5 to 15 percent, lithology of fragments is dominantly granite, gneiss, and schist

Reaction: neutral in the surface horizon; slightly alkaline to moderately alkaline in the underlying horizons

A horizon

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 2 or 3, dry or moist

Rock fragments: total range is 60 to 85 percent

25 to 35 percent pebbles

20 to 30 percent cobbles

0 to 12 percent stones

0 to 20 percent boulders

C1 and C2 horizons

Value: 6 or 7 dry, 5moist

Chroma: 2 or 3, dry or moist

Rock fragments: total range is 35 to 50

20 to 35 percent pebbles

5 to 15 percent cobbles

0 to 7 percent stones

C3 horizons

Value: 6 or 7 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Rock fragments: total range is 15 to 25

5 to 15 percent pebbles

5 to 10 percent cobbles

2C4 horizon

Value: 8 dry, 7 moist

Chroma: 1, dry or moist

3C5 horizon

Value: 6 or 7 dry, 5 or 6 moist

Chroma: 5 or 6, dry or moist

Rock fragments: 20 to 30 percent pebbles

Andanada Series

Classification: Loamy skeletal, mixed, superactive, calcareous, mesic Andic Lithic Ustorthents

Depth class: Very shallow

Drainage class: Well drained

Permeability: Moderately rapid

Landform: Summit of mesa

Parent material: Alluvium and residuum derived from volcanic ash and pumice

Slope range: 2 to 10 percent

Elevation: 6,500 to 6,700 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 47 to 49 degrees F.

Frost-free period: 120 to 140 days

Typical Pedon

Andanada gravelly sandy loam--on the summit of a mesa sloping 4 percent to the south at 6,630 feet

elevation--rangeland. Santa Fe County, New Mexico; about 2.5 miles north of White Rock; 600 feet east and 600 feet south of the northwest corner of section 28, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 18 seconds North and Longitude 106 degrees 12 minutes 42 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted.)

A--0 to 2 inches; grayish brown (10YR 5/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few fine and common very fine roots; few very fine interstitial pores; 30 percent pebbles; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw--2 to 5 inches; grayish brown (10YR 5/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few medium, common fine and few very fine roots; few fine tubular pores; 50 percent pebbles; moderately alkaline (pH 8.2); abrupt smooth boundary.

2Cr--5 to 9 inches; white (10YR 8/1) soft tuff bedrock, light gray (10YR 7/1) moist; few medium and few fine roots; moderately alkaline (pH 8.4); clear wavy boundary.

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 49 to 51 degrees F.

Particle-size control section weighted averages:

Silicate clay content: 8 to 18 percent; Rock fragment

content: 35 to 60 percent, mostly pebbles, lithology of fragments pumice and tuff

Reaction: Moderately alkaline

A horizons

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2 or 3, dry or moist

Rock fragments: 25 to 35 percent pebbles

Bw horizons

Value: 4 or 5 dry; 3 or 4 moist

Chroma: 2 or 3, dry or moist

Texture: very gravelly sandy loam or very channery sandy loam

Rock fragments: 40 to 60 percent pebbles

Canuela Series

Classification: Fine-loamy, mixed, superactive, mesic Lithic Haplustalfs

Parent material: Alluvium and residuum derived from volcanic ash and pumice

Depth class: Shallow

Drainage class: Well drained

Permeability: 0 to 2 inches—moderately rapid, 2 to 16 inches—moderate, 16 inches—very slow

Landform: Summits of mesas

Slope range: 3 to 8 percent

Elevation: 6,500 to 6700 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 47 to 49 degrees F.

Frost-free period: 120 to 140 days

Typical Pedon

Canuela sandy loam--on a summit of a mesa sloping 3 percent to the west at 6,580 feet elevation--rangeland. Santa Fe County, New Mexico; about 2.25 miles north of White Rock; 1750 feet east and 650 feet south of the northwest corner of section 28, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 18 seconds North and

Longitude 106 degrees 12 minutes 28 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted. When described, the soil was dry throughout.)

A--0 to 2 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; few medium and many fine roots; few fine interstitial pores; 10 percent pebbles; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bt--2 to 7 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; common medium, common fine, and few very fine roots; common medium and few fine tubular pores; few distinct clay films on faces of peds and common faint clay films on faces of peds; 2 percent pebbles; slightly alkaline (pH 7.8); gradual smooth boundary.

Btk--7 to 16 inches; light brown (7.5YR 6/4) extremely paracobbly loam, brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; few medium, common fine, and few very fine roots; few fine tubular pores; common faint clay films on faces of peds; 80 percent paracobbles; strongly effervescent, secondary calcium carbonate segregated as few fine irregularly shaped coats on faces of peds; moderately alkaline (pH 8.2); abrupt smooth boundary.

2R—16 inches; hard tuff bedrock

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and

June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 49 to 51 degrees F.

Depth to base of argillic horizon: 10 to 20 inches

Depth to calcareous material (as visible secondary calcium carbonate): 4 to 12 inches

Volcanic glass content: 1 to 3 percent

Particle-size control section weighted averages:

Silicate clay content: 18 to 27 percent; Sand content: 40 to 60 percent; Fine sand or coarser content: 20 to 40 percent; Rock fragment content: 0 to 10 percent pebbles, lithology of fragments is tuff

Reaction: slightly alkaline in the surface and upper part of the subsoil and moderately alkaline in the lower part of the subsoil

A horizon

Value: 5 or 6 dry, 3 or 4 moist

Chroma: 2 or 3, dry or moist

Rock fragments: 5 to 15 percent pebbles

Bt horizon

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 3 or 4, dry or moist

Texture: loam or sandy clay loam

Rock fragment content: 0 to 5 percent pebbles

Btk horizon

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 4 or 5, dry or moist

Texture: extremely paracobbly loam or very paracobbly loam

Pararock fragment content: 50 to 85 percent paracobbles

Calcium carbonate equivalent: 1 to 5 percent

Estante Series

Classification: Loamy-skeletal, mixed, superactive, mesic Aridic Haplustalfs

Depth class: Very deep

Drainage class: Well drained

Parent material: Alluvium derived from basalt and tuff over residuum derived from volcanic ash and pumice

Permeability: Moderately rapid in the surface, moderate in the upper part of the subsoil, moderately rapid in the middle part of the subsoil, moderate in the lower part of the subsoil, and moderately rapid in the substratum

Landform: Risers of high stream terraces

Slope range: 25 to 50 percent

Elevation: 6,400 to 6,500 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 47 to 49 degrees F.

Frost-free period: 120 to 140 days

Typical Pedon

Estante extremely gravelly coarse sandy loam, very stony--on the riser of a high stream terrace sloping 42 percent to the east-southeast at 6,440 feet elevation--woodland. Santa Fe County, New Mexico; about 3 miles northwest of White Rock; 2500 feet west and 2450 feet south of the northeast corner of section 20, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 50 seconds North and Longitude 106 degrees 13 minutes 18 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted.)

A--0 to 3 inches; brown (10YR 5/3) extremely gravelly coarse sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine and many very fine roots; common very fine irregularly shaped pores; 60 percent pebbles, 10 percent cobbles, and 3 percent stones on the soil surface; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bt1--3 to 6 inches; brown (7.5YR 5/4) very gravelly sandy clay loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly

sticky and slightly plastic; common fine and common very fine roots; few fine and few very fine tubular pores; few distinct clay films on rock fragments and common faint clay films on ped faces; 35 percent pebbles and 5 percent cobbles on the soil surface; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bt2--6 to 11 inches; light reddish brown (5YR 6/4) very gravelly sandy clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; few coarse, few medium, common fine, and common very fine roots; common very fine tubular pores; few distinct clay films on faces of peds and bridging; 45 percent pebbles and 5 percent cobbles; moderately alkaline (pH 8.4); clear smooth boundary.

Bt3--11 to 16 inches; reddish brown (5YR 5/4) very gravelly coarse sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few coarse, few medium, few fine, and common very fine roots; few very fine tubular pores; few faint clay films on faces of peds and bridging; 40 percent pebbles and 10 percent cobbles; moderately alkaline (pH 8.2); abrupt smooth boundary.

2Bt4--16 to 23 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few very coarse, few coarse, and few medium roots; few medium, common fine, and few very fine tubular pores; few distinct and few faint clay films on faces of peds; <2 percent pebbles; moderately alkaline (pH 8.2); clear smooth boundary.

2Bt5--23 to 44 inches; light brown (7.5YR 6/4) loam, strong brown (7.5YR 4/6) moist; weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine and common

very fine tubular pores; <2 percent pebbles; moderately alkaline (pH 8.4); clear smooth boundary.

2BC--44 to 60+ inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; moderate medium platy structure; hard, friable, slightly sticky and nonplastic; <2 percent pebbles; moderately alkaline (pH 8.4).

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 48 to 50 degrees F.

Depth to base of argillic horizon: 21 to 29 inches

Particle-size control section weighted averages:

Silicate clay content: 27 to 34 percent; Sand content: 35 to 60 percent; Fine sand or coarser content: 35 to 55 percent; Rock fragment content: 35 to 60 percent, lithology of fragments is granite, gneiss, and schist

Reaction: slightly alkaline in the surface and the upper part of the subsoil; moderately alkaline in lower part of the subsoil

A horizon

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 3 or 4, dry or moist

Rock fragments: total range is 60 to 73 percent
55 to 65 percent pebbles
5 to 15 percent cobbles
2 to 3 percent stones

Bt1 horizon

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 3 or 4, dry or moist

Rock fragments: total range is 30 to 50 percent
30 to 40 percent pebbles

5 to 10 percent cobbles

Bt2 horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Rock fragments: total range is 45 to 60 percent
35 to 55 percent pebbles
5 to 10 percent cobbles

Bt3 horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or 4 moist

Rock fragments: total range is 40 to 55 percent
35 to 45 percent pebbles
5 to 15 percent cobbles

2Bt4 horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Rock fragments: <2 percent pebbles

2Bt5 horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 4 or 5 dry, 5 or 6 moist

Rock fragments: <2 percent pebbles

2BC horizons

Value: 5 or 6 dry, 4 or 5 dry

Chroma: 3 or 4, dry or moist

Rock fragments: <2 percent pebbles

Kayefes Series

Classification: Coarse-loamy, mixed, superactive, mesic, Aridic Lithic Haplustepts

Depth class: Shallow

Drainage class: Well drained

Permeability: Moderately rapid

Landform: Summits of mesas

Parent material: Eolian material and residuum derived from tuff and volcanic ash

Slope range: 6 to 12 percent

Elevation: 6,500 to 6,700 feet

Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 49 degrees F.
Frost-free period: 120 to 140 days

Typical Pedon

Kayefes sandy loam--on a mesa summit sloping 10 percent to the southwest at 6,640 feet elevation--rangeland. Santa Fe County, New Mexico; about 2.25 miles north of White Rock; 700 feet south and 700 feet east of the northwest corner of section 28, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 17 seconds North and Longitude 106 degrees 12 minutes 40 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted. When described, the soil was dry throughout.)

Oi--0 to 2 inches; slightly decomposed needles and twigs

A--2 to 4 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; few fine and many very fine roots; few fine interstitial pores; 2 percent pebbles; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk--4 to 6 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few medium, common fine, and few very fine roots; few fine interstitial pores; 10 percent pebbles; strongly effervescent; secondary calcium carbonate segregated as common fine irregularly shaped coats on faces of peds and common medium coats on rock fragments; strongly alkaline (pH 8.6); clear wavy boundary. moderately alkaline (pH 8.4); abrupt smooth boundary.

2Bk2--6 to 8 inches; white (10YR 8/1) extremely paracobbly sandy loam, light gray (10YR 7/1) moist; weak fine granular structure; soft, very friable,

slightly sticky and nonplastic; few medium and few fine roots; 30 percent paragravels and 35 percent paracobbles; strongly effervescent; secondary calcium carbonate segregated as common fine irregularly shaped coats on faces of peds and common very fine coats on rock fragments; slightly alkaline (pH 7.6); abrupt smooth boundary.

2Bk3--8 to 11 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common very coarse, few coarse, common medium, few fine, and few very fine roots; 5 percent pebbles; strongly effervescent; strongly alkaline (pH 8.6); abrupt smooth boundary.

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 49 to 51 degrees F.

Particle-size control section weighted averages: Silicate clay content: 8 to 18 percent; Sand content: 50 to 70 percent; Fine sand or coarser content: 40 to 60 percent; Rock fragment content: 5 to 15 percent, lithology of fragments is mostly pumice.

Reaction: moderately alkaline in the surface horizon; slightly to moderately alkaline in the subsurface horizons

A horizon

Value: 5 or 6 dry, 3 or 4 moist

Chroma: 3 or 4, dry or moist

Rock fragments: 0 to 5 percent pebbles

Bk horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Rock fragments: 5 to 10 percent pebbles

Calcium carbonate equivalent: 1 to 5 percent

2Bk2 horizon

Value: 7 or 8 dry, 6 or 7 moist

Chroma: 1 or 2, dry or moist

Rock fragments: Total range is 60 to 75 percent
parafragments

25 to 35 percent parapebbles

30 to 40 percent paracobbles

Calcium carbonate equivalent: 3 to 5 percent

2Bk3 horizon

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 2 or 3, dry or moist

Rock fragments: 0 to 10 percent pebbles

Calcium carbonate equivalent: 5 to 15 percent

Levante Series

Classification: Sandy, mixed, mesic Aridic
Ustifluvents

Depth class: Very deep

Drainage class: Excessively drained

Permeability: Moderately rapid in the loamy strata
and rapid or very rapid in the sandy horizons

Landform: Flood plains of valley floors

Parent material: Alluvium derived from granite,
gneiss, schist, and granitic sandstone

Slope range: 1 to 4 percent

Elevation: 6,000 to 7,300 feet

Mean annual precipitation: 12 to 15 inches

Mean annual air temperature: 47 to 50 degrees F.

Frost-free period: 140 to 160 days

Typical Pedon

Levante loamy sand--on a slightly convex flood
plain sloping 2 percent to the south at 7,100 feet
elevation--rangeland. Santa Fe County, New

Mexico; about 2 miles north of downtown Santa
Fe within the nonsectionized Santa Fe Grant;
USGS Santa Fe 7.5 minute topographic
quadrangle; Latitude 35 degrees 42 minutes 44
seconds North and Longitude 105 degrees 56
minutes 39 seconds West, NAD 27. (Colors are
for dry soil unless otherwise noted. When
described, the soil was moist 0 to 10 and 45 to 122
inches, dry from 10 to 45 inches, and wet below
122 inches.)

AC--0 to 4 inches; brown (7.5YR 5/3) loamy
sand, brown (7.5YR 4/3) moist; weak fine
granular structure; soft, very friable, slightly sticky
and nonplastic; few fine and common very fine
roots; thin lens of fine sand; 5 percent pebbles;
strongly effervescent; slightly alkaline (pH 7.8);
clear wavy boundary. (3 to 6 inches thick)

C1--4 to 17 inches; light brown (7.5YR 6/3)
coarse sand, brown (7.5YR 5/3) moist; single
grain; loose, nonsticky and nonplastic; few fine
and common very fine roots; one lens of very
gravelly coarse sand, one lens of fine sandy loam,
and one strata of sandy loam 2 inches thick at 15
to 17 inches; 10 percent pebbles; strongly
effervescent; slightly alkaline (pH 7.8); abrupt
wavy boundary.

C2--17 to 32 inches; light brown (7.5YR 6/3)
gravelly coarse sand, brown (7.5YR 4/3) moist;
single grain; loose, nonsticky and nonplastic; few
fine and common very fine roots; one 1 inch
stratum of gravelly coarse sandy loam which
thickens to a loam three inches thick; 30 percent
pebbles; strongly effervescent; moderately
alkaline (pH 8.4); abrupt wavy boundary.

C3--32 to 45 inches; brown (7.5YR 5/3) stratified
gravelly loamy coarse sand and gravelly coarse
sand, brown (7.5YR 4/4) moist; massive; soft,
very friable, slightly sticky and nonplastic; few
medium, few fine, and common very fine roots; 25
percent pebbles; slightly effervescent; moderately
alkaline (pH 8.4); abrupt smooth boundary.

C4--45 to 58 inches; brown (7.5YR 5/4) gravelly loamy coarse sand, brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky and nonplastic; few very fine roots; few lamina of sandy loam near base of horizon; 20 percent pebbles; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

C5--58 to 86 inches; light brown (7.5YR 6/3) gravelly coarse sand, brown (7.5YR 5/3) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; 25 percent pebbles; slightly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

C6--86 to 122 inches; light brown (7.5YR 6/3) very gravelly coarse sand, brown (7.5YR 5/3) moist; single grain; loose, nonsticky and nonplastic; 40 percent pebbles; slightly effervescent; moderately alkaline (pH 8.2). (Combined thickness of the C horizons is more than 80 inches)

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on torric(ustic).

Soil temperature: 49 to 52 degrees F.

Particle-size control section weighted averages:
Silicate clay content: 0 to 8 percent; Rock fragment content: 15 to 35 percent, lithology of fragments is granite, gneiss, and schist

Reaction: slightly alkaline in the surface; slightly alkaline to moderately alkaline in the underlying materials

Calcium carbonate equivalent: 3 to 10 percent in upper horizons; 1 to 3 percent in lower horizons

Salinity, mmhos/cm: 0 to 1

AC horizon

Value: 5 or 6 dry, 4 or 5 moist

Texture: loamy sand or gravelly coarse sand

Rock fragments: 5 to 35 percent pebbles

Other features: this horizon is a recent stratified deposit and does not qualify as an Ochric epipedon

upper C horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Texture: stratified very gravelly coarse sand to sandy loam

Rock fragments: 5 to 35 percent pebbles

Other features: pedons have thin strata, lenses, and laminae ranging in texture from coarse sandy loam to loam

lower C horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Texture: stratified coarse sandy loam to very gravelly coarse sand, with individual layers stratified and variable in gravel content and fine-earth texture

Rock fragments: 5 to 45 percent pebbles

Other features: some pedons have buried horizons of gravelly coarse sandy loam to loam below 40 inches

Navajita Series

Classification: Coarse-loamy, mixed, superactive, mesic Aridic Haplustafs

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderately rapid

Landform: Fan remnants

Parent material: Eolian material and alluvium derived from volcanic ash and tuff

Slope range: 5 to 15 percent

Elevation: 6,300 to 6,500 feet

Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F.
Frost-free period: 120 to 140 days

Typical Pedon

Navajita sandy loam--on a planar north-facing fan remnant sloping 12 percent to the north at feet elevation--rangeland. Santa Fe County, New Mexico; about 2.5 miles north of White Rock; 1,250 feet south and 1,450 feet east of the northwest corner of section 21, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 30 seconds North and Longitude 106 degrees 12 minutes 48 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted.)

A--0 to 3 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, very friable, slightly sticky and nonplastic; common fine and common very fine roots; common very fine interstitial pores; 2 percent pebbles; neutral (pH 7.2); abrupt smooth boundary.

Bt1--3 to 15 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine and common very fine roots; common fine and few very fine tubular pores; few faint on faces of peds; 2 percent pebbles; slightly alkaline (pH 7.4); clear smooth boundary.

Bt2--15 to 25 inches; yellowish brown (10YR 5/4) sandy loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few medium, common fine and few very fine roots; few fine and few very fine tubular pores; few faint clay films on faces of peds; 10 percent pebbles; slightly alkaline (pH 7.4); clear smooth boundary.

Bk1--25 to 38 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 5/3) moist; weak fine

subangular blocky; slightly hard, friable, slightly sticky and nonplastic; few coarse, few medium, common fine and few very fine roots; few fine and common very fine tubular pores; 10 percent pebbles; strongly effervescent, secondary calcium carbonate segregated as few fine irregularly shaped coats on faces of peds and on rock fragments; slightly alkaline (pH 7.8); clear smooth boundary.

Bk2--38 to 51 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common medium and common fine roots; few fine and few very fine tubular pores; 5 percent pebbles; strongly effervescent, secondary calcium carbonate segregated as few fine irregularly shaped coats on faces of peds and on rock fragments; moderately alkaline (pH 8.0); clear smooth boundary.

2Btb--51 to 62 inches; brown (7.5YR 5/3) sandy clay loam, brown (7.5YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common medium and few very fine roots; few very fine tubular pores; few distinct and common faint clay films on faces of peds; 5 percent pebbles; slightly alkaline (pH 7.8); abrupt smooth boundary.

2Btkb--62 to 81 inches; light brown (7.5YR 6/3) sandy clay loam, brown (7.5YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and few very fine roots; few very fine tubular pores; common faint clay films on faces of peds; 10 percent pebbles; strongly effervescent, secondary calcium carbonate segregated as few fine irregularly shaped coats on faces of peds and on rock fragments; moderately alkaline (pH 8.0).

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 48 to 50 degrees F.

Depth to base of argillic horizon: 20 to 30 inches

Depth to calcareous material (as visible secondary calcium carbonate): 20 to 30 inches

Volcanic glass content: 1 to 5 percent in the coarse silt and very fine sand fractions

Particle-size control section weighted averages:

Silicate clay content: 12 to 18 percent; Sand content: 50 to 70 percent; Fine sand or coarser content: 45 to 60 percent; Rock fragment content: 2 to 10 percent pebbles, lithology of fragments is pumice and tuff.

A horizon

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 3, dry or moist

Texture: sandy loam

Bt1 horizon

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 3 or 4, dry or moist

Texture: sandy loam or fine sandy loam

Bt2 horizons

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 3 or 4, dry or moist

Texture: sandy loam or fine sandy loam

Rock fragments: 5 to 15 percent pebbles

Bk1 horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Texture: sandy loam or fine sandy loam

Rock fragments: 5 to 15 percent pebbles

Calcium carbonate equivalent: 1 to 5 percent

Bk2 horizons

Hue: 10YR

Value: 6 through 7 dry, 3 or 4 moist

Chroma: 3 or 4, dry or moist

Texture: sandy loam

Rock fragments: 5 to 10 percent pebbles

Calcium carbonate equivalent: 2 to 5 percent

2Btb horizons

Hue: 7.5YR

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Texture: sandy clay loam

Rock fragments: 2 to 10 percent pebbles

2Btkb horizons

Hue: 7.5YR

Value: 6 or 7 dry, 5 or 6 moist

Chroma: 3 or 4, dry or moist

Texture: sandy clay loam

Rock fragments: 2 to 10 percent

Negrita Series

Classification: Sandy, mixed, mesic Torrifluventic
Haplustolls

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Rapid to very rapid in the sandy horizons and strata and moderately rapid in the loamy horizons and strata

Landform: Low stream terraces of valley floors

Parent material: Alluvium derived from granite, gneiss, and schist

Slope range: 1 to 3 percent

Elevation: 6,500 to 7,300 feet

Mean annual precipitation: 13 to 15 inches

Mean annual air temperature: 47 to 50 degrees F.

Frost-free period: 140 to 160 days

Typical Pedon

Negrita sandy loam--on a slightly convex part of a low stream terrace sloping 2 percent to the southwest at 6,895 feet elevation--rangeland. Santa Fe County, New Mexico; about 5.5 miles southeast of Seton Village within the nonsectionized Canada de los Alamos Land Grant; USGS Seton Village 7.5 minute topographic quadrangle; Latitude 35 degrees 31 minutes 30.5 seconds North and Longitude 105 degrees 53 minutes 10.5 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted. When described, the soil was dry from the surface to 55 inches, slightly moist from 55 to 80 inches, and dry below 80 inches.)

A1--0 to 3 inches; brown (7.5YR 5/3) sandy loam, dark brown (7.5YR 3/3) moist; weak thin platy structure parting to weak fine granular; soft, very friable, slightly sticky and nonplastic; common fine and common very fine roots; few very fine irregularly shaped pores; very few, 1-4 mm wide pieces of charcoal; 10 percent pebbles; neutral (pH 6.6); clear smooth boundary. (2 to 6 inches thick)

A2--3 to 10 inches; brown (7.5YR 4/2) gravelly coarse sandy loam, dark brown (7.5YR 3/2) moist; weak medium granular structure; soft, very friable, slightly sticky and nonplastic; few fine and common very fine roots; common very fine irregularly shaped pores; very few, 1-4 mm wide pieces of charcoal; 20 percent pebbles; neutral (pH 6.8); clear wavy boundary. (3 to 9 inches thick)

AC--10 to 14 inches; brown (7.5YR 4/3) gravelly loamy coarse sand, dark brown (7.5YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few fine and common very fine roots; very few, 1-4 mm wide pieces of charcoal; 25 percent pebbles; very slightly effervescent in spots; neutral (pH 6.8); clear wavy boundary. (4 to 9 inches thick)

C1--14 to 22 inches; brown (7.5YR 5/3 with 7.5YR 4/3) gravelly coarse sand, brown (7.5YR 4/3) with dark brown (7.5YR 3/3) moist; single grain; loose, nonsticky and nonplastic; few fine and few very fine

roots; one thin lens of sandy loam; 15 percent pebbles; very slightly effervescent in spots; neutral (pH 7.0); clear irregular boundary.

C2--22 to 29 inches; brown (7.5YR 5/3) very gravelly coarse sand, brown (7.5YR 4/3) moist; single grain; loose, nonsticky and nonplastic; few fine and few very fine roots; 45 percent pebbles; neutral (pH 7.0); abrupt smooth boundary.

C3--29 to 49 inches; brown (7.5YR 5/3 with 7.5YR 4/3) gravelly coarse sand, brown (7.5YR 5/3) with dark brown (7.5YR 3/2) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; common laminae of gravelly coarse sandy loam; 20 percent pebbles; neutral (pH 7.2); abrupt smooth boundary.

C4--49 to 85 inches; brown (7.5YR 5/3) stratified gravelly coarse sand and very gravelly coarse sand, brown (7.5YR 4/3) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; few laminae of loamy coarse sand and one stratum of coarse sand; 25 to 50 percent pebbles; neutral (pH 7.2); clear smooth boundary.

C5--85 to 98 inches; brown (7.5YR 4/3) sandy loam, dark brown (7.5YR 3/3) moist; massive; soft, very friable, slightly sticky and nonplastic; 10 percent pebbles; slightly alkaline (pH 7.4); gradual smooth boundary.

C6--98 to 106 inches; brown (7.5YR 5/3) gravelly loamy sand, dark brown (7.5YR 3/2) moist; massive; soft, very friable, slightly sticky and nonplastic; 20 percent pebbles; neutral (pH 7.0). (Combined thickness of the C horizons is more than 80 inches)

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than

40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soil is driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 49 to 52 degrees F.

Depth to base of mollic epipedon: 10 to 19 inches

Particle-size control section weighted averages:

Silicate clay content: 0 to 8 percent; Rock fragment content: 15 to 35 percent, lithology of fragments is granite, gneiss, and schist

Organic matter content: 1 to 3 percent in the mollic epipedon

Calcium carbonate equivalent: the surface is noncalcareous with 0 percent; 0 to 3 percent in lower C horizons, non-secondary (disseminated) in nature

Salinity, mmhos/cm: 0 to 1 in the surface, subsurface, and upper part of the underlying material; 0 to 2 in the lower part of the underlying material

Reaction: neutral in the surface; neutral to slightly alkaline in the subsurface and underlying material

A1 horizon

Value: 4 or 5 dry

Chroma: 2 or 3, dry or moist

Rock fragments: 5 to 15 percent pebbles

A2 horizon

Value: 3 through 5 dry, 2.5 or 3 moist

Chroma: 2 or 3, dry or moist

Texture: gravelly coarse sandy loam, sandy loam, or gravelly loamy coarse sand

Rock fragments: 10 to 25 percent pebbles

Other features: some pedons have texture of loamy sand

AC horizon

Value: 3 through 5 dry, 2.5 or 3 moist

Chroma: 2 or 3, dry or moist

Texture: stratified gravelly coarse sandy loam to gravelly coarse sand

Rock fragments: total range is 5 to 35 percent, averaging 15 to 30 percent pebbles

Other features: some pedons have thin strata or lenses of sandy loam or gravelly loam

upper C horizons

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 2 through 4, dry or moist

Texture: stratified gravelly loamy coarse sand to very gravelly coarse sand

Rock fragments: total range is 15 to 50 percent, averaging 25 to 40 percent pebbles

Other features: pedons have thin subhorizons, strata, laminae, and lenses with texture ranging from sand to silt loam

lower C horizons

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 2 through 4, dry or moist

Texture: stratified sandy loam to gravelly loamy coarse sand

Rock fragments: total range is 5 to 35 percent, averaging 10 to 25 percent pebbles

Other features: pedons have thin subhorizons, strata, laminae, and lenses with texture of fine sandy loam, very fine sandy loam, very gravelly loamy coarse sand, or very gravelly coarse sand; some pedons have buried B horizons with texture of loam below 40 inches

Palatka Series

Classification: Coarse-loamy, mixed, superactive, nonacid, mesic Aridic Ustorthents

Depth class: Very shallow

Drainage class: Well drained

Permeability: Moderately rapid

Landform: North-facing backslopes of mesas

Parent material: Eolian material and alluvium derived from volcanic ash, tuff and pumice

Slope range: 20 to 75 percent

Elevation: 6,400 to 6,700 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 46 to 48 degrees F.

Frost-free period: 120 to 140 days

Typical Pedon

Palatka sandy loam--on the north-facing backslope of mesas sloping 45 percent to the south at 6,580 feet elevation--rangeland. Santa Fe County, New Mexico; about 2.5 miles north of White Rock; 350 feet east and 200 feet south of the northwest corner of section 28, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 22 seconds North and Longitude 106 degrees 12 minutes 44 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted.)

Oi--0 to 1 inches; slightly decomposed needles, twigs, leaves and cones.

A--1 to 2 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular structure; soft, very friable, nonsticky and nonplastic; many fine and common very fine roots; few very fine interstitial pores; 5 percent pebbles; neutral (pH 6.8); abrupt smooth boundary.

AB--2 to 5 inches; grayish brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few medium, common fine and common very fine roots; few very fine interstitial pores; 10 percent pebbles; neutral (pH 7.0); clear wavy boundary.

Bw--5 to 7 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common medium, common fine and few very fine roots; few very fine tubular pores; 25 percent pebbles; neutral (pH 7.0); clear smooth boundary.

2Cr--7 to 11 inches; white (10YR 8/1) soft tuff bedrock, light brownish gray (10YR 6/2) moist;

common medium and few fine roots; neutral (pH 6.8); abrupt smooth boundary.

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 48 to 50 degrees F.

Particle-size control section weighted averages:

Silicate clay content: 2 to 10 percent; Rock fragment content: 35 to 70 percent, mostly pebbles, lithology of fragments is granite, gneiss, and schist

Reaction: Neutral

Oi horizon

Needles, twigs, leaves and cones

A horizons

Value: 4, 5 or 7 dry; 3, 4 or 7 moist

Chroma: 2 or 3 dry, 2 or 3 moist

Texture: Very cobbly sandy loam, gravelly sandy loam, and sandy loam

Rock fragments: total range is 5 to 55 percent

5 to 25 percent pebbles

0 to 20 percent cobbles

AB horizons

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 2 or 3, dry or moist

Texture: sandy loam

Rock fragments: 5 to 15 percent pebbles

Bw horizons

Value: 4 or 5 dry, 3 through 5 moist

Chroma: 2 or 3, dry or moist

Texture: gravelly sandy loam

Rock fragments: 20 to 30 percent pebbles

2Cr horizons

Value: 8 dry, 6 moist

Chroma: 1 or 2, dry or moist

Texture: Soft tuff bedrock

Piojillo Series

Classification: Mixed, mesic Aridic Ustipsamments

Depth class: Very deep

Drainage class: Somewhat excessively drained

Permeability: Moderately rapid

Landform: Treads of fan remnants

Parent material: Alluvium derived from pumice and volcanic ash

Slope range: 3 to 15 percent

Elevation: 6,400 to 6,600 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 48 to 50 degrees F.

Frost-free period: 120 to 140 days

Typical Pedon

Piojillo gravelly loamy coarse sand--on a tread of a fan remnant sloping 14 percent to the south at 6,440 feet elevation--rangeland. Santa Fe County, New Mexico; about 2 miles north-northwest of White Rock; 600 feet west and 850 feet north of the southeast corner of section 20, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 32 seconds North and Longitude 106 degrees 12 minutes 56 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted. When described, the soil was dry throughout.)

A1--0 to 3 inches; pale brown (10YR 6/3) gravelly loamy coarse sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common fine and few very fine roots; few fine interstitial pores; 20 percent pebbles; neutral (pH 6.8); abrupt smooth boundary. (2 to 3 inches thick)

A2--3 to 6 inches; pale brown (10YR 6/3) gravelly loamy coarse sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common fine and few very fine roots; few fine tubular pores; 15 percent pebbles; neutral (pH 7.0); abrupt smooth boundary. (2 to 3 inches thick)

Bw1--6 to 10 inches; pale brown (10YR 6/3) loamy coarse sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few medium, few fine, and few very fine roots; few medium and few fine interstitial pores; 15 percent pebbles; neutral (pH 7.2); clear smooth boundary. (4 to 13 inches thick)

Bw2--10 to 21 inches; pale brown (10YR 6/3) loamy coarse sand, brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common coarse, common medium, few fine and few very fine roots; common medium and few fine tubular pores; neutral (pH 7.2); clear smooth boundary. (6 to 12 inches thick)

C1--21 to 35 inches; pale brown (10YR 6/3) loamy coarse sand, brown (10YR 4/3) moist; single grain structure; loose, nonsticky and nonplastic; many medium and few fine roots; common fine tubular pores; 15 percent pebbles; neutral (pH 7.2); clear smooth boundary. (8 to 19 inches thick)

C2--35 to 84 inches; very pale brown (10YR 7/4) gravelly loamy coarse sand, yellowish brown (10YR 5/4) moist; single grain structure; loose, nonsticky and nonplastic; common medium and common fine roots; few medium and few fine tubular pores; 20 percent pebbles; very slightly effervescent; moderately alkaline (pH 8.4). (6 to 49 inches thick)

C3--84 to 110 inches; very pale brown (10YR 7/3) gravelly loamy coarse sand, yellowish brown

(10YR 5/4) moist; single grain structure; loose, nonsticky and nonplastic; 15 percent pebbles; slightly effervescent; moderately alkaline (pH 8.4).

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 49 to 51 degrees F.

Volcanic glass content: 5 to 10 percent in the coarse sand fractions

Particle-size control section weighted averages:

Silicate clay content: 4 to 8 percent; Sand content: 60 to 90 percent; Fine sand or coarser content: 50 to 80 percent; Rock fragment content: 10 to 35 percent pebbles, lithology of fragments is pumice

Reaction: neutral in the upper part and moderately alkaline in the lower part

A horizon

Hue: 7.5YR or 10YR

Value: 4 to 6 dry, 3 or 4 moist

Chroma: 2 or 3, dry or moist

Rock fragments: 15 to 35 percent pebbles

Bw horizons

Hue: 7.5YR or 10YR

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 3 or 4, dry or moist

Texture: loamy coarse sand, gravelly loamy coarse sand, and gravelly loamy sand

Rock fragment content: 10 to 35 percent pebbles

C horizons

Hue: 7.5YR or 10YR

Value: 6 or 7 dry, 4 to 6 moist

Chroma: 2 through 4, dry or moist

Texture: loamy coarse sand, gravelly loamy coarse sand, and gravelly loamy sand

Rock fragment content: 15 to 30 percent pebbles

Potente Series

Classification: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Petrocalcic Paleustalfs

Depth class: Moderately deep

Drainage class: Well drained

Permeability: Slow to moderately slow in the subsoil and rapid to very rapid in the substratum

Landform: Treads of high stream terraces

Parent material: Alluvium derived from basalt and quartzite

Slope range: 3 to 15 percent

Elevation: 6,400 to 6,500 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 47 to 49 degrees F.

Frost-free period: 120 to 140 days

Typical Pedon

Potente gravelly loam--on a tread of a stream terrace sloping 7 percent to the east at 6,465 feet elevation--rangeland. Santa Fe County, New Mexico; about 2.25 miles north of White Rock; 2,550 feet east and 2,400 feet south of the northwest corner of section 20, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 52 seconds North and Longitude 106 degrees 13 minutes 20 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted. When described, the soil was dry throughout.)

A--0 to 3 inches; brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine and common very fine roots; few very fine interstitial pores; 25 percent

pebbles and 5 percent cobbles; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bt1--3 to 6 inches; reddish brown (5YR 5/3) clay loam, brown (5YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, moderately sticky and moderately plastic; few fine and few very fine roots; few fine tubular pores; common faint clay films on faces of peds; 10 percent pebbles; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bk1--9 to 13 inches; pink (7.5YR 7/3) gravelly loam, pink (7.5YR 6/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 20 percent pebbles; strongly effervescent, secondary calcium carbonate segregated as few coarse irregularly shaped concretions; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk2--13 to 17 inches; pink (7.5YR 7/3) gravelly sandy loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; 25 percent pebbles and 5 percent cobbles; violently effervescent, secondary calcium carbonate disseminated throughout the matrix and segregated as common coarse irregularly shaped concretions; moderately alkaline (pH 8.4); abrupt smooth boundary.

2Bk3--17 to 22 inches; pinkish white (7.5YR 8/2) very gravelly loamy coarse sand, pink (7.5YR 7/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few very fine roots; 30 percent pebbles and 10 percent cobbles; violently effervescent, secondary calcium carbonate disseminated throughout the matrix; moderately alkaline (pH 8.4); abrupt smooth boundary.

2Bk4--22 to 26 inches; white (7.5YR 8/1) very gravelly coarse sand, pinkish gray (7.5YR 7/2) moist; strong thick platy structure; soft, very friable,

nonsticky and nonplastic; few very fine roots; 20 percent pebbles and 20 percent cobbles; violently effervescent, secondary calcium carbonate disseminated throughout the matrix; strongly alkaline (pH 8.6).

Bkqm--26 to 32 inches; petrocalcic horizon

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 49 to 51 degrees F.

Depth to base of argillic horizon: 6 to 10 inches

Depth to calcareous material (as visible secondary calcium carbonate): 8 to 12 inches

Depth to calcic horizon: 8 to 16 inches

Depth to petrocalcic horizon: 20 to 36 inches

Volcanic glass content: 1 to 5 percent in the fine and very fine sand fractions

Particle-size control section weighted averages:

Silicate clay content: 35 to 45 percent in the upper part of the subsoil and 18 to 35 percent in the lower part of the subsoil averaging 27 to 35 percent, 2 to 8 percent in the lower part of the control section; Sand content: 30 to 45 percent in the upper part and 70 to 90 percent in the lower part; Fine sand or coarser content: 20 to 35 percent in the upper part and 60 to 80 percent in the lower part; Rock fragment content: 5 to 15 percent pebbles in the upper part and 35 to 50 percent pebbles in the lower part, lithology of fragments is basalt and quartzite

Reaction: slightly alkaline in the surface and upper subsoil and moderately in the lower subsoil and substratum

A horizon

Value: 4 or 5 dry, 3 or 4 moist

Chroma: 2 or 3, dry or moist

Rock fragments: 20 to 35 percent total rock fragments

20 to 30 percent pebbles

0 to 5 percent cobbles

Bt1 horizon

Value: 4 or 5, dry or moist

Chroma: 3 or 4, dry or moist

Texture: clay loam or clay

Rock fragment content: 5 to 15 percent pebbles

Bt2 horizon

Value: 5 or 6 dry, 4 or 5 moist

Chroma: 2 or 3, dry or moist

Rock fragment content: 5 to 15 percent pebbles

Bk1 horizon

Value: 7 or 8 dry, 6 or 7 moist

Chroma: 2 or 3 dry, 3 or 4 moist

Texture: gravelly loam or gravelly fine sandy loam

Rock fragments: 15 to 30 percent pebbles

Calcium carbonate equivalent: 20 to 40 percent

Bk2 horizon

Value: 7 or 8 dry, 6 or 7 moist

Chroma: 3 or 4 dry, 4 or 5 moist

Texture: gravelly sandy loam or gravelly fine sandy loam

Rock fragments: total range is 20 to 35 percent

20 to 30 percent pebbles

0 to 5 percent cobbles

Calcium carbonate equivalent: 25 to 45 percent

2Bk3 horizon

Value: 7 or 8 dry, 6 or 7 moist

Chroma: 2 or 3 dry, 3 or 4 moist

Texture: very gravelly loamy coarse sand or very gravelly coarse sand

Rock fragments: total range is 35 to 55 percent

30 to 45 percent pebbles

5 to 10 percent cobbles

Calcium carbonate equivalent: 10 to 20 percent

2Bk4 horizon

Value: 7 or 8 dry, 6 or 7 moist

Chroma: 1 or 2 dry, 2 or 3 moist

Texture: clay loam or clay

Rock fragments: total range is 35 to 55 percent

25 to 35 percent pebbles

10 to 20 percent cobbles

Calcium carbonate equivalent: 30 to 45 percent

Other features: Horizon contains 10 to 20 percent petronodes

Zacaton Series

Classification: Coarse-loamy, mixed, superactive, mesic Vitrandic Haplustepts

Depth class: Very deep

Drainage class: Well drained

Permeability: Moderately rapid

Landform: North-facing backslopes of mesas

Parent material: Colluvium over residuum

derived from pumice and volcanic ash

Slope range: 25 to 50 percent

Elevation: 6,400 to 6,700 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 46 to 48 degrees F.

Frost-free period: 110 to 130 days

Typical Pedon

Zacaton very cobbly sandy loam--on a linear backslope sloping 52 percent to the north at 6,520 feet elevation--woodland. Santa Fe County, New Mexico; about 2.5 miles north of White Rock; 200 feet east and 100 feet south of the northwest corner of section 28, T.19N., R.7E.; USGS White Rock 7.5 minute topographic quadrangle; Latitude 35 degrees 51 minutes 23 seconds North and Longitude 106 degrees 12 minutes 46 seconds West, NAD 27. (Colors are for dry soil unless otherwise noted.)

Oi—0 to 1 inch; slightly decomposed twigs, needles and cones

A--1 to 3 inches; grayish brown (10YR 5/2) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; common fine and many very fine roots; common fine irregularly shaped pores; 20 percent pebbles, 20 percent cobbles, and 5 percent stones; neutral (pH 7.2); abrupt smooth boundary.

Bw--3 to 9 inches; pale brown (10YR 6/3) cobbly sandy loam, brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few medium, common fine, and many very fine roots; common fine and few very fine interstitial pores; 15 percent pebbles, 10 percent cobbles, and 5 percent stones; slightly alkaline (pH 7.6); clear smooth boundary.

Bk1--9 to 18 inches; pale brown (10YR 6/3) gravelly sandy loam, light brown (10YR 4/3) moist; moderate weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few coarse, common medium, common fine, and common very fine roots; few fine and common very fine interstitial pores; 20 percent pebbles and 10 percent cobbles; none to slightly effervescent, secondary calcium carbonate segregated as few fine irregularly shaped coats on faces of peds and on rock fragments; slightly alkaline (pH 7.4); clear smooth boundary.

Bk2--18 to 32 inches; white (10YR 8/2) very cobbly loam, very pale brown (10YR 7/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few coarse, common medium, common fine, and few very fine roots; few fine and few very fine tubular pores; 15 percent pebbles, 15 percent cobbles and 10 percent stones; violently effervescent, secondary calcium carbonate segregated as common fine irregularly shaped coats on faces of peds and on rock fragments; very strongly alkaline (pH 9.4); abrupt smooth boundary.

Bk3--32 to 48 inches; very pale brown (10YR 7/3) gravelly sandy loam, yellowish brown (7.5YR 4/4) moist, weak medium granular structure; soft, very friable, slightly sticky and nonplastic; common medium, common fine, and few very fine roots; few very fine tubular pores; 10 percent pebbles and 10 percent cobbles; strongly effervescent, secondary calcium carbonate segregated as common fine irregularly shaped coats on rock fragments; very strongly alkaline (pH 9.4); clear smooth boundary.

Bk4--48 to 63 inches; very pale brown (10YR 7/3) gravelly sandy loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few medium, common fine and many very fine roots; common fine and few very fine tubular pores; 15 percent pebbles and 5 percent cobbles; strongly effervescent, secondary calcium carbonate segregated as few fine irregularly shaped coats on rock fragments; very strongly alkaline (pH 9.4); gradual wavy boundary.

Ck--63 to 76 inches; pink (5YR 7/4) gravelly loamy coarse sand, yellowish red (5YR 5/6) moist; single grain; loose, nonsticky and nonplastic; 25 percent pebbles; none to slightly effervescent, secondary calcium carbonate segregated as few fine irregularly shaped coats on rock fragments; strongly alkaline (pH 8.8); abrupt smooth boundary.

C—76 to 102 inches; pink (5YR 8/4) gravelly loamy coarse sand, yellowish red (5YR 5/6) moist; single grain; loose; nonsticky and nonplastic; 30 percent pebbles; strongly alkaline (pH 8.6).

Range in Characteristics

Soil moisture: The soil moisture control section is moist in all parts during the 60 days following the

winter solstice. It is moist in some part less than 40 percent and moist in all parts less than 25 percent of the time when the soil temperature at 20 inches is above 41 degrees F. The soils are driest in May and June. The soil moisture regime is ustic bordering on aridic.

Soil temperature: 48 to 50 degrees F.

Particle-size control section weighted averages:

Silicate clay content: 8 to 18 percent; Sand content: 40 to 60 percent; Fine sand or coarser content: 30 to 50 percent; Rock fragment content: 20 to 35 percent, lithology of fragments is dominantly pumice

Depth to Calcic horizon: 15 to 30 inches

Reaction: neutral in the surface horizon; moderately alkaline to very strongly alkaline in the underlying horizons

Salinity, mmhos/cm: 0 to 1 in the upper part of the profile; 0 to 4 in the lower part of the profile

Sodicity, SAR: 0 to 1 in the surface; 0 to 4 in the underlying material

A horizon

Value: 4 or 5 dry, 3 moist

Chroma: 2 or 3, dry or moist

Rock fragments: total range is 35 to 60 percent

15 to 25 percent pebbles

15 to 25 percent cobbles

0 to 5 percent stones

5 to 10 percent boulders

Bw horizon

Value: 5 dry, 3 or 4 moist

Chroma: 2 or 4, dry or moist

Texture: cobbly sandy loam, gravelly sandy loam, and cobbly loam

Rock fragments: total range is 20 to 35 percent

5 to 15 percent pebbles

0 to 15 percent cobbles

0 to 5 percent stones

Bk1 horizon

Value: 6 dry, 4 or 5 moist

Chroma: 2 through 4 dry, 2 through 4 moist

Texture: gravelly sandy loam and cobbly sandy loam

Rock fragments: Total range is 15 to 40 percent

15 to 20 percent pebbles

0 to 15 percent cobbles

0 to 10 percent stones

Calcium carbonate equivalent: 15 to 25 percent

Lower Bk horizons

Value: 5 through 8 dry, 4 through 7 moist

Chroma: 2 through 4 dry, 2 through 4 moist

Texture: gravelly loam or gravelly sandy loam

Rock fragments: Total range is 15 to 35 percent

10 to 20 percent pebbles

5 to 15 percent cobbles

Calcium carbonate equivalent: 2 to 5 percent

C and Ck horizons

Hue: 5YR, 7.5YR or 10 YR

Value: 7 or 8 dry, 5 to 7 moist

Chroma: 1 through 4 dry, 2 through 6 moist

Texture: gravelly loamy coarse sand and gravelly loamy sand

Rock fragments: 25 to 30 percent pebbles

Calcium carbonate equivalent: 0 to 2 percent

Formation of the Soils

This section defines soil, describes the factors of soil formation, and relates them to the formation of the soils in Tsankawi Area.

Soil, as used in this publication, is a natural body or a collection of natural bodies on the earth's surface, containing living matter and supporting or capable of supporting plant life. Its upper limit is air or shallow water. At its margins it grades to deep water or to barren areas of rock. Soil grades at its lower limit to bedrock or to earthy materials virtually devoid of roots, animals, or marks of other biologic activity (USDA, 1975; USDA, 1992). Soil is a dynamic medium forming a living shell of varying thickness over the rocky crust of the Earth.

Soil is the result of the interaction of five soil forming factors (Birkeland, 1984; Jenny, 1941). These factors determine the unique properties and characteristics of a soil at any given location. The five soil forming factors are: (1) the type and mineralogical composition of the *parent material*; (2) the *living organisms* on and in the soil; (3) the *topography* or "lay of the land"; (4) the different *climates* that the soil has been exposed to; and (5) the length of *time* these development forces have acted upon the soil. The interrelationship of these factors is very complex and it is difficult to isolate the effects of any one factor. The effect of the factors also varies from place to place, but the interaction of the factors ultimately determines the kind of soil that forms. The term "pedogenesis" (soil genesis) is often used to connote the process of soil formation.

Parent Material

Parent material is the unconsolidated organic and mineral matter in which soil forms. Parent materials influence or wholly determine the color, texture, mineralogy, structure, consistency, reaction, erodibility, and natural fertility of soil.

Most mineral matter is ultimately derived from some type of rock. The Tsankawi Area has landscapes that in some areas are dominated by exposed bedrock. The vast majority of the bedrock types present here are igneous rocks. These rock layers are grouped together into mapable units called formations. Physical and chemical weathering of rocks in these exposed geologic formations, accompanied by natural erosion, provides an abundant source of loose rock debris for the parent materials of soils.

Since the parent materials derived from particular geologic formations have specific characteristics, the soils that form in them tend to have similar characteristics. Certain other properties such as mineralogy and soil color are strongly influenced by the initial nature of the parent materials. These

predictable properties are especially evident in dry regions where the rate of chemical weathering of parent materials is generally slow due to the lack of abundant soil moisture.

The soils in the Tsankawi Area formed in several types of parent material. Some soils have formed in only one type of material, while many others have formed in a combination of several of the different types. The parent materials present are alluvium, residuum, colluvium, and eolian material. All of these types of materials are discussed in the following paragraphs.

Alluvium is sediment that has been moved by water. It may have been moved many miles or only a few feet. In this survey area, it commonly is derived from a bedrock such as shale, but it may also be derived from existing soils which are undergoing accelerated erosion.

Alluvial deposits are typically stratified due to the fluctuating nature of the processes involving erosion, transportation, and deposition of sediments. This inherent stratification is clearly evident in very young alluvial deposits, but is less evident in deposits where pedogenesis has altered or obscured it. Differences in particle or grain sizes due to stratification plays an important role in the diagnostic horizons which may form in a soil. For example, calcic horizons in soils typically form over or in layers which have distinct differences in grain size. This effect is due to the difference in the size of the pores between different strata or layers, which affects water flow. These different layers slow the movement of soil water and allow compounds such as calcium carbonate held in suspension to be withdrawn into large soil pores where they accumulate over time.

Some soils in the Tsankawi Area forming in Holocene alluvium lack diagnostic subsurface horizons and have properties which are a direct result of the parent material.

Common landforms or landform positions in this survey area where alluvium is a dominant parent material are flood plains, alluvial fans, stream terraces, toeslopes, and footslopes. The high stream terrace in the northwest part of the survey area is a distinctive feature denoting much older age.

Residuum is material formed in place by the physical and chemical weathering of bedrock.

Common landform positions in this survey area where residuum is an important parent material are summits of mesas, plateaus, and structural benches.

Colluvium is material that has been moved down steep slopes by mass wasting processes. It is largely material that has rolled, slid, or fallen down slope due to the influence of gravity. The size fractions of particles in most colluvial deposits are large and the material is unsorted. The rock fragments in colluvium are usually angular, except where the fragments are derived from rock formations or unconsolidated deposits that have preexisting, rounded fragments.

Colluvium is an important soil parent material on backslope.

Eolian material is sediment that has been carried and deposited by wind. It commonly is sand and silt, but may also be aggregates of clay-size particles. Eolian materials may move many miles in the case of silt and very fine sand, or relatively short distances in the case of fine or medium sand. Calcium carbonate and other chemical compounds such as sodium sulfate are also moved and redeposited by wind in the form of dust (Gile, et al., 1981; Harden, et al., 1991; USDA, 1979). Such atmospheric additions of dry clay and fine silt-size particles has a significant cumulative effect over a long period of time, especially on stable landform positions. Labile calcium released by calcareous dust into the soil water may combine with the sulfate anion present in saline soils to form accumulations of secondary gypsum.

Loess is the term for eolian material of dominantly silt-sized particles.

Living Organisms

Living organisms have a significant effect on the formation of soil. Plant, animal, and microbial life affect such processes as the physical and chemical weathering of bedrock and parent material, the rates of organic matter decomposition and biochemical transformation, and plant nutrient cycling, to name a few. Plants probably exert the greatest influence on soil formation. Plant roots grow into bedrock and parent material, breaking it loose into individual particles. Roots exert strong pressures to force open joints in rock and unconsolidated materials, making them more porous. Some plants cycle nutrients from great depths in the soil, making them available to other plants and animals.

Animals have an impact on soil formation. Creatures such as ants, earthworms, cicada larvae, mice, moles, prairie dogs, and badgers live and burrow in the soil. Their activities mix layers and concentrate soil particles, while also increasing porosity, permeability, and recycling plant matter and nutrients. Microorganisms such as certain soil bacteria participate vigorously in the basic enzymatic transformations of nitrification, sulfur oxidation, and nitrogen fixation (Brady, 1974). These are processes that are vital if a soil is to support higher plants. Actinomycetes are bacteria-like fungi which are of great importance in the decomposition of soil organic matter and are also partly responsible for the aroma of fresh soil. Certain species of fungi may aid or speed the accumulation of calcium carbonate within desert soils (Monger et al., 1991).

Field research by ecologists is revealing the growing importance that algae and spore producing plants play in the health and stability of

fragile soils in dry regions. Cryptogamic soil crusts form on and directly under the soil surface when symbiotic communities of algae, fungi, mosses, and lichens flourish. These cryptogam crusts are characteristically dark and lumpy and can become well developed on sandy, saline, or gypsiferous soils which lack gravel lags or desert pavements. These firm crusts are important because they stabilize and protect otherwise sparsely vegetated soils from the hazards of water erosion and soil blowing (Anderson et al, 1982; Brotherson et al, 1983). Other benefits which cryptogam crusts provide is adding organic matter, fixing atmospheric nitrogen, increasing water infiltration, and increasing moisture content of the upper inch of soil (Dunne, 1989).

Humans alter the soil by building structures, manipulating rangeland plants for livestock, harvesting or chaining trees, and by leveling, tilling, planting, and irrigating for crop production. All of these activities can cause serious soil erosion if care is not taken by land users. Humankind's actions may have a beneficial effect if stewardship of the soil resource is practiced.

Topography

Topography has an important influence on soil formation, due both to the slope gradient and the aspect. Slope gradient determines the rate of surface runoff and the hazard of soil erosion by water. The Zacaton soil has a rapid rate of surface runoff and a severe hazard of water erosion due to steep slopes, resulting in only minimal soil development. By contrast, the Piojillo soil has a slow rate of surface runoff and a slight hazard of water erosion due to being on more gentle slopes.

Topography also affects the internal drainage of soils.

The aspect, or direction a slope faces, can also affect soil formation. Steep north-facing slopes have cooler, more moderate temperatures and more

effective soil moisture than steep south-facing slopes.

Topography affects the climatic factors of soils in areas of deeply entrenched canyons. The phenomenon of nighttime cold air drainage down into canyons effectively lengthens the frost-free period of soils on adjacent uplands, while shortening the period for the soils on the canyon floors (Erdman, et al., 1969).

Climate

Climate plays an important role in the formation of soils. Climate is a dynamic factor that fluctuates monthly and yearly in the mid-latitudes in response to the seasons. It has also undergone significant global changes over the long span of geologic time. A change in climate alters the balance of other soil forming factors, and soils often display morphologic features which formed under the influence of past climates. Many soils in dry regions which have argillic horizons overlying well developed calcic horizons probably display the effects of changing climates. The early Holocene epoch was a time of continent-wide climatic change. Additions of calcium carbonate due to increasingly arid conditions caused engulfment of argillic horizons by secondary carbonate accumulations.

Temperature and precipitation are the most important climate factors in this survey area. A wide range of soil temperature and moisture regimes are possible in soils due to differences in these climatic factors. Soil temperature regimes in the survey area range from mesic at low and middle elevations to cryic on distinct north aspects at the highest elevations.

Temperature affects the rate of biological activity, the rate of decomposition of organic matter, and the rate of certain chemical reactions. Some rates

effectively double for every 10 degree C. rise in temperature (Brady, 1974).

Regional and local weather patterns determine when, what types, and in what amounts precipitation will fall. The Tsankawi Area has a distinct bi-seasonal pattern of precipitation with significant amounts of moisture coming in winter and summer. Soils at the higher elevations receive much more winter precipitation than those at the lower elevations. Moisture coming in the winter in the form of snow and gentle rain eventually penetrates deeply into soil profiles and is very effective for leaching. Spring months are normally dry and windy with little rainfall. The strong spring winds intensify the dry climate and deplete soil moisture through high evaporation rates. Moisture coming in summer when evapotranspiration rates are higher, penetrates to only very shallow depths. Summer moisture typically comes as heavy rainfall from high-intensity thunderstorms of short duration. These summer monsoon storms, occurring between July and September, are isolated in extent and undependable in occurrence. Much of the moisture that falls from such storms runs off the soil surfaces and is unavailable for plant growth.

Soil moisture affects the types of native vegetation present, the rate of biologic activity, the rate of leaching of chemical compounds, and the degree of illuviation of soil colloids. Within certain limits, increasing amounts of soil moisture will result in an increasing amount of leaching and illuviation.

Time

The length of time that parent materials have been exposed to the effects of climate and living organisms is an important factor in soil development. In general, the longer the time period that a soil has been forming, the stronger the degree of expression of its diagnostic horizons. Soil age is the measure of this length of time and is determined by several methods.

The development of carbonate (Bk) horizons of pedogenic origin is closely related to soil age (Gile, et al., 1981; USDA, 1979). Soils with horizons of calcium carbonate accumulation are very common in the survey area. A sequence of four stages of carbonate accumulation allows estimates of development time to be made on soils having these genetic horizons.

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Glossary

Adsorption. The process by which atoms, molecules, or ions are taken up from the soil solution or soil atmosphere and retained on the surfaces of solids by chemical or physical binding.

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 are called peds. Clods are aggregates produced by tillage or logging.

Albic horizon. A subsurface horizon from which silicate clay and/or free iron oxides have been removed or the oxides segregated to the extent that the color of the horizon is largely determined by the color of the primary sand and silt particles.

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. Soil parent material, such as cobbles, gravel, sand, silt, or clay, deposited on land by flowing water from streams or rivers.

Aquic conditions. Current soil wetness characterized by continuous or periodic saturation and reduction. The presence of these conditions is indicated by redoximorphic features, and can be verified, except in artificially drained soils, by measuring saturation and reduction.

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

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

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

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

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

Backslope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Backslopes in profile are commonly steep, are linear, and may or may not include cliff segments. Backslopes are erosional forms.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Surface runoff potential is very high, and geologic erosion is active.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Basalt. Igneous rock formed by the cooling and hardening of a magma associated with volcanic activity and emplaced at or near the earth's surface.

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.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

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

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Bouldery. Surface phases of soils having boulders on the surface horizon in amounts high enough to interfere with cultivation, harvest, or trafficability. The limits for the phase classes expressed as percent of surface covered are:

Bouldery.....0.01 to 0.1
Very bouldery.....0.1 to 3
Extremely bouldery.....3 to 15
Rubbly.....15 to 75

Rubble land.....more than 75

Stones may occupy a greater proportion of the surface in these phases so long as the boulders dominate the stones as a limiting factor for use and management. Rubble land is not soil, but rather is treated as a kind of miscellaneous area.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated, small tableland or volcanic neck with relatively steep slopes and talus or precipitous cliffs and characterized by summit width that is less than the height of bounding escarpments. The small summits are flat in tableland or pointed in volcanic necks. As summit area increases relative to height in tablelands, buttes are transitional to mesas.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Calcic horizon. A subsoil horizon characterized by an illuvial accumulation of secondary calcium carbonate. Calcic horizons are not cemented or indurated to a degree which would be limiting to root growth.

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

Cambic horizon. A subsoil horizon characterized by loamy texture, soil structure rather than rock structure, and some evidence of alteration such as illuviation of clay or removal and redistribution of calcium carbonate. A cambic horizon can include layers that are part of an ochric epipedon or an albic horizon.

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

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). The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channer. A thin, flat fragment of rock such as sandstone, limestone, slate, schist, or (rarely) basalt, as much as 6 inches along the longest axis.

Channery soil material. Material that is 15 to 35 percent, by volume thin, flat rock fragments, as much as 6 inches (15 centimeters) along the longest axis. Very channery soil material is 35 to 60 percent of these fragments, and extremely channery soil material is more than 60 percent.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Chroma. The relative purity or strength of a spectral color. Chroma indicates the degree of saturation of neutral gray by the spectral color. (See Munsell notation)

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.

Claystone. Sedimentary rock which is formed by the hardening of a clay deposit, and has an angular or irregular fracture. It is similar to shale, but lacks the platy lamination or fissility.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of illuviated, oriented, silicate clay on the surface face of a soil ped or lining pores. Illuvial clay may also coat surfaces of

rock fragments or form bridges between adjacent rock fragments or sand grains.

Climate factor (C). The climatic characterization of windspeed and surface soil moisture used in the wind erosion equation to determine an erodibility index and hazard of soil blowing classes. The climate factors used in this survey are assigned from estimates of soil moisture and temperature regimes in the following manner:

Soil moisture, temperature symbols	C factor	Soil map unit
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Typic aridic, mesic.....	100 to 295; 500 to 528.....	120
Ustic aridic, mesic.....	300 to 320.....	80
Aridic ustic, mesic.....	400 to 418.....	60
Typic ustic, frigid.....	600 to 712.....	40

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.

Cobbles. Rounded or partly rounded fragments of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter. An individual piece is a cobble.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Colluvium. Unsorted soil parent material which was transported and deposited on steep slopes and/or the base of sloped by mass movement

(direct gravitational action) and by local, unconcentrated runoff.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil 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.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

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.

Coppice dune. A small dune of fine grained soil material stabilized around shrubs or small trees.

Corrosion. The potential or risk of soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

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

Cropping system. Growing crops according to a planned system of rotation and management practices.

Cretaceous. The third period of the Mesozoic Era of geologic time (from approximately 135 to 65 million years ago).

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure,

organic matter content, and fertility and helps to control erosion.

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

Cryptogam. The association of certain species of spore producing plants which grow on or directly under the soil surface in arid, semiarid, and subhumid areas. These plants produce algal filaments, fungal mycelia, and exudates, that firmly bind and cement soil separates into a dark, lumpy crust. These crusts stabilize the surfaces of many sandy, saline, and gypsiferous soils which helps protect them from erosion. Cryptogam crusts are easily damaged by excessive foot, hoof, or wheel traffic.

Cuesta. A hill or ridge that has a gentle slope on one side and a steep slope on the other; specifically, an asymmetric, homoclinal ridge capped by resistant rock layers of slight or moderate dip.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Deltaic. A term pertaining to present or past landforms or environments associated with deltas.

Depth class, soil. Generally, the thickness of the soil over root-limiting layers such as bedrock or a pan. Very deep soils are more than 60 inches deep over bedrock or a pan; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Desert pavement. On a desert surface, a layer of gravel or larger fragments that was emplaced by upward movement of the underlying sediments or that remains after finer particles have been removed by running water or the wind.

Dike. An intrusive, tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks.

Dipslope. A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock which has been tilted from the horizontal plane by earth movements such as folding or flexure. (see Cuesta)

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Dome. A smoothly rounded landform or rock mass such as the rock-capped summit of a mountain .

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.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

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.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

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

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of 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 tablelands and the building up of such landscape features as flood plains and alluvial fans. 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.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess gypsum (in tables). Excess gypsum in the soil. Gypsum is a corrosion hazard for concrete and soils high in gypsum may subside if the gypsum is dissolved and removed by water.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces. Older, dissected fan terraces may have a gently sloping, planar summit surface (tread) built by fan deposition, and a steep, descending slope (riser), graded to a lower base level of erosion.

Fast intake (in tables). The rapid movement of water into the soil.

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

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity .

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.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

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.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Footslope. The geomorphic component that forms the inner, inclined surface at the base of a hill. Footslopes in profile are dominantly concave, and

may form transition zones between upslope sites of erosion (backslope) and downslope sites of deposition. (toeslope).

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.

Formation (stratigraphy). The basic rock-stratigraphic unit in the local classification of rocks. A body of rock (commonly a sedimentary stratum or strata, but also igneous and metamorphic rocks) generally characterized by some degree of internal lithologic homogeneity or distinctive lithologic features (such as chemical composition, structures, textures, or general kind of fossils), by a prevailing (but not necessarily tabular shape), and by mappability at the earth's surface (at scales of the order of 1:25,000) or traceability in the subsurface. Formations may be combined into groups or subdivided into members.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Geomorphic surface. A mapable area of the earth's surface that has a common history; the area is of similar age and is formed by a set of processes during an episode of landscape evolution. A geomorphic surface can be erosional, constructional, or both. The surface shape can be

planar, concave, convex, or any combination of these.

Geomorphology. The science of landforms that treats the general configuration of the earth's surface; especially the study of the classification, description, nature, origin, and development of landforms and their relationships to underlying structures, and of the history of geologic changes as recorded by these surface features. The term is especially applied to the genetic interpretation of landforms.

Gleyed soil material. Soil horizons that formed under saturation with stagnant water, resulting in the reduction of iron and other elements. Gleyed horizons have low chroma and gray matrix colors.

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. Very gravelly soil material is 35 to 60 percent of these fragments, and extremely gravelly soil material is more than 60 percent.

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

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

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

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsic horizon. A subsoil horizon characterized by an illuvial accumulation of secondary gypsum. Gypsic horizons are not cemented or indurated to a degree which would be limiting to root growth.

Gypsiferous material. Soil material that has more than 10 percent gypsum (hydrous calcium sulfate). Gypsum is a soft, soluble mineral and soil layers which are gypsiferous material are not represented with entries in the table "Engineering Index Properties", except for depth and fragments larger than 3 inches. Such layers are described with apparent USDA textures in the sections "Detailed Soil Map Units" and "Soil Series and Their Morphology".

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

Hazard of soil blowing. A narrative term describing the potential of soil surfaces, in cultivated or bare disturbed areas, to blow during periods of strong sustained winds. The soil properties used to determine soil blowing hazard are soil texture, organic matter content, calcium carbonate reaction, rock fragment content, aggregate stability, moisture, and soil loss tolerance (T factor). Wind erodibility index (I value) is intended to represent most of the above permanent properties. Climate factor (C) and wind erodibility index are used, along with soil loss tolerance factor, in the Wind Erosion Equation to determine soil blowing hazard (see Wind erosion equation and Climate factor). In this survey the following five soil blowing hazard classes are recognized based on calculated values from the wind erosion equation and assigned values of wind erodibility index:

Very severe.....C_xI/T is more than 20 and I is 134 to 310
Severe.....C_xI/T is more than 20

Moderate.....C_xI/T is 8 to 20
Slight.....C_xI/T is less than 8 and I is more than 0
Very slight.....C_xI/T is less than 8 and I is 0

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

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. Hills commonly have a descending order of geomorphic components that include summits, shoulders, backslopes, footslopes, and toeslopes. However, all of these components are not necessarily present in every hillslope continuum. In addition, these geomorphic components are also used to subdivide broader, more complex landforms such as escarpments, landslides, mountains, and plateaus.

Holocene. The second epoch of the Quaternary Period of geologic time, extending from the end of the Pleistocene Epoch (about 10 to 12 thousand years ago) to the present.

Horizon, soil. A layer of soil, approximately parallel to the land surface, having distinct characteristics produced by soil-forming processes and differing from adjacent genetically related layers in physical, chemical, and biological factors. In the identification of soil horizons, an uppercase letter represents the master horizons. Numbers or lowercase letters that follow represent subdivisions of the master horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The master horizons of mineral soil are as follows:

O horizon. =An organic layer of 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. A horizons exhibit soil structure as well as obliteration of all or much of the original rock structure. 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 dominated by the obliteration of all or much of the original rock structure. The B horizon also has distinctive characteristics, such as (1) accumulation of silicate clay, calcium carbonate, gypsum, sodium, or a combination of these; (2) prismatic, granular, columnar, 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. 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 layer. =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.

Hue. The property of color that is perceived by the eye and measured on the Munsell color system. The Munsell system is based on five principal hues: red (R), yellow (Y), green (G), blue (B), and purple (P). Five intermediate hues representing midpoints between each pair of principal hues

complete the 10 major hue names used to describe the notation. The most common intermediate hues in soil are yellow-red (YR) green-yellow (GY), and blue-green (BG).

(See Munsell notation.)

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

Hydric soil. A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic (oxygen-depleted) conditions in the upper part. Hydric soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

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.

Hydrophytic vegetation. Plant life growing in water or on a substrate (usually soil) that is at least periodically deficient in oxygen as a result of excessive water content.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

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

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

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

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

Less than 0.1: very slow
0.1 to 0.3: slow
0.3 to 0.5: moderately slow
0.5 to 0.75: moderate
0.75 to 1.0: moderately rapid
1.0 to 1.5: rapid
More than 1.5: very rapid

Interdunes. The relatively flat surface, whether sand-free or sand-covered, between dunes.

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

* **Border.** Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

* **Corrugation.** Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

* **Drip (or trickle).** Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

* **Furrow.** Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

* **Sprinkler.** Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Jurassic. The second period of the Mesozoic Era of geologic time (from approximately 195 to 135 million years ago).

Knoll. A small, low, rounded hill rising above adjacent landforms.

Laccolith. An intrusive, mushroom-shaped body of igneous rock that has domed up the overlying rocks into which it was intruded.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lamellae. The thin, sometimes wavy subhorizons of fine materials that are present in some soils as a result of illuviation. They form when silicate clay is pedogenically concentrated (illuviated) within coarser (e.g. sandy) eluviated horizons. A lamella is a single illuvial horizon less than 7.5 centimeters thick. Lamellae may be present in sufficient

thickness and quantity to influence certain soil properties such as water-holding capacity.

Lamina. The thinnest recognizable layer, (commonly less than 1 centimeter thick), of original deposition in a sediment or sedimentary rock, differing from other layers in color, composition, or particle size.

Landform. Any physical, recognizable form or feature on the earth's surface, having a characteristic shape and range in composition, and produced by natural causes. Landforms include a wide range in size and provide an empirical description of similar portions of the earth's surface.

Landslide. A general term for a mass movement landform and a process characterized by moderately rapid to rapid (greater than 30 centimeters per year) downslope transport, by means of gravitational stresses, of a mass of rock and regolith that may or may not be water saturated.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

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

Littoral. A term pertaining to present or past landforms and environments bordering an ocean or inland sea. Examples are beaches, barrier islands, salt marshes, and lagoons.

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. (in tables). The soil is not strong enough to support loads.

Marine. A term pertaining to an open ocean or inland sea, and to oceanic conditions in the present or geologic past.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Matrix, soil. The dominant volume, in a soil horizon, which is continuous in appearance and envelops microsites.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

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

Mesa. A broad, nearly flat topped and commonly isolated upland mass (tableland) characterized by summit widths that are more than the heights of bounding erosional escarpments.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

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

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

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

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.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Monocline. A unit of folded strata that flexes from the horizontal in one direction only, and is not part of an anticline or syncline. This structure is typically present in plateau areas where nearly flat strata locally assume steep dips caused by differential vertical movements without faulting.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Such colors are described as redoximorphic features if they are the result of soil wetness. Descriptive terms are as follows: abundance= few, common, and many; size= fine, medium, and coarse; and contrast= faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables=hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

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

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

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.

Ochric epipedon. A surface horizon that is generally thin, dry, light in color, high in value or chroma, and/or low in organic matter. Ochric epipedons

include eluvial horizons (such as albic horizons) that are at or near the soil surface.

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, cemented pan, indurated calcium carbonate pan, plowpan, and traffic pan.

Parent material. The unconsolidated organic and mineral matter 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.

Pedogenesis. The term used to connote soil formation. Pedogenic processes, as opposed to geologic processes, are those which involve the soil forming factors in the development and differentiation of soils and their horizons.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

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

Petrocalcic horizon. A subsoil horizon characterized by an illuvial accumulation of secondary calcium carbonate. In a petrocalcic horizon, the carbonates have accumulated to the extent that the horizon is cemented or indurated and is limiting to root growth.

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

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

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

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

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

Plateau. An extensive upland mass (tableland) with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Pleistocene. The first epoch of the Quaternary Period of geologic time, following the Tertiary Pliocene Epoch and preceding the Holocene (from approximately 2 million to 10 thousand years ago).

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

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

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

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.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Porcelanite. Metamorphic rock formed by the baking and fusing of shale and sandstone beds associated with burned coal seams.

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.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

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.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Quaternary. The second period of the Cenozoic Era of geologic time, extending from the end of the Tertiary Period (about 2 million years ago) to the present, and comprising two epochs, the Pleistocene (Ice Age) and Holocene (Recent).

Quartzite. Metamorphic rock formed from sandstone by heat, pressure, and strong silica cementation.

Quartz diorite. Igneous rock formed by the cooling and hardening of a magma associated with plutonic activity and intruded at depth below the earth's surface.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair,

or poor on the basis of how much the present plant community has departed from the potential.

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

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

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

Ultra acid: 3.4 and lower

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

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

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.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Reduction. The gain of one or more electrons by an ion or molecule. The degree of reduction in a soil can be characterized by a direct measurement of oxidation-reduction (redox) potentials. A degree of reduction that results in the transformation of ferric iron (Fe III) to ferrous iron (Fe II) is used to define the characteristic of aquic conditions.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

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.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to wheeled and tracked equipment.

Riparian. A term pertaining to plants and animals living on, or adjacent to, the bank or flood plain of an intermittent stream or perennial river.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

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

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

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

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

Salic horizon. A mineral soil horizon characterized by an accumulation of salts which are more soluble than gypsum in cold water.

Saline-sodic soil. A soil that contains both soluble salts and exchangeable sodium in amounts that interfere with the growth of most crop plants. The conductivity of the saturation extract is more than 4 mmhos/cm, and the exchangeable sodium percentage is more than 15 percent (sodium adsorption ratio of 13 or more). Saline-sodic soils typically do not have the poor physical properties characteristic of sodic soils.

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

Salinity. The degree to which a soil is affected by soluble salts dissolved in water. Salinity is expressed as the electrical conductivity of a saturated extract in millimhos per centimeter (mmhos/cm). The degrees of salinity and their respective electrical conductivity values are:

Nonsaline.....	less than 2
Very slightly saline.....	2 to 4
Slightly saline.....	4 to 8
Moderately saline.....	8 to 16
Strongly saline.....	more than 16

Salty water (in tables). Water that is too salty for consumption by livestock.

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.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

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.

Scribner rule. A logarithmic rule, developed by J.M. Scribner around 1846, that is a table or formula showing estimated volumes in board feet for various log diameters and lengths.

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; siltstone, formed from silt and very fine sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. 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 and having the tendency to split into thin layers (i.e., fissibility).

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The geomorphic component that forms the uppermost, inclined surface at the top of a hill. It is dominantly convex in profile, erosional in origin, and comprises a transition zone between summits above, and backslopes below.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen which forms the molecule and compound silicon dioxide, SiO₂. The highly crystalline, common mineral form is called quartz.

Silicate. A compound or mineral that contains silica and a metallic or organic radical. Silicates are the most common soil and rock-forming minerals and constitute over 90 percent of the earth's crust. Most soil clays belong to a class of silicate minerals known as phyllosilicates, which are characterized by having platy cleavage.

Sill. An intrusive body of igneous rock of approximately uniform thickness and relatively thin compared with its lateral extent, which has been emplaced parallel to the bedding of the intruded rocks.

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.

Slickrock. An unusual type of Rock outcrop, which commonly occurs in arid, semiarid, (and dry-subhumid) portions of the Canyon Lands and

adjacent sections, of the Colorado Plateau physiographic province. It has formed from thick beds of moderately cemented, fine-grained sandstone; and has been sculptured by geologic erosion into smooth-textured, rounded to irregular forms as alcoves, arches, domes, fins, flatirons, knobs, natural bridges, needles, and potholes. Slickrock occurs in sizable areas on the dipslopes of cuestas and monoclines, rims of mesas and plateaus, summits of structural benches, and on canyon headwalls.

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

Slickspot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and supports little or no vegetation.

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

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic soil. A soil that contains exchangeable sodium in amounts that interfere with the growth of most crop plants. Sodic soils have more than 15 percent exchangeable sodium (sodium adsorption ratio of 13 or more) and are also strongly or very strongly alkaline (pH 8.5 or higher). They restrict plant growth due to the poor physical condition of the soil caused by the dispersal of clay particles.

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:

Nonsodic: less than 5:1

Slightly sodic: 5-13:1

Moderately sodic: 13-30:1

Strongly sodic: More than 30:1

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 topography 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: .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.

Stones. Rounded or angular fragments of rock 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Surface phases of soils having stones on the surface horizon in amounts high enough to interfere with cultivation, harvest, or trafficability. The limits for the phase classes expressed as percent of surface covered are:

Phase

Stony: 0.01 to 0.1

Very stony: 0.1 to 3

Extremely stony: 3 to 15

Stony: 15 to 75

Rubble land: more than 75

Rubble land is not soil, but rather is treated as a kind of miscellaneous area.

Stratified. Arranged in strata, or layers. The term refers to either soil or geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the dissected remnants of an abandoned flood plain, stream bed, or valley floor produced during a former stage of erosion and deposition. Older and higher stream terraces have a relatively flat summit surface (tread), built by stream deposition, and a steep

descending slope (riser), graded to a lower base level of erosion.

Structural bench. A platform-type, nearly level to gently inclined erosional landform developed on resistant strata in areas where geologic erosion has cut into alternating hard and soft rock layers with an essentially horizontal attitude. Structural benches are bedrock-controlled, their profiles are stair-stepped and angular, they commonly have summits of variable width, and are bounded both above and below, by hills or escarpments.

Structure, rock. The primary arrangement of minerals, small particles, and rock fragments which is inherited from the parent material. As opposed to soil structure, rock structure is not formed by the processes of soil formation. Included in the concept of rock structure are the fine stratifications in alluvium and the fissile or angular arrangement of soft rock fragments in some C horizons formed in residuum derived from sedimentary bedrock.

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

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summit. A general term for the top, or highest area of a landform such as a butte, hill, mountain, structural bench, mesa, or plateau. Summits may or may not include distinct crest lines or high points that rise above their general level.

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.

Tableland. A general term for a broad upland mass with nearly level or undulating summit area of large extent and steep slopes descending to surrounding lowlands. Common types of tablelands are plateaus, mesas, and some buttes.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Taxadjuncts. Such soils are correlated and named as recognized, existing soil series for the purpose of expediency. They are so like the soils of the named series in morphology, properties, and interpretative behavior the little of nothing is gained by adding a new soil series.

Tertiary. The first period of the Cenozoic Era of geologic time (from approximately 65 to 2 million years ago).

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic

textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

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

Toeslope. The geomorphic component that forms the outermost, gently- inclined surface at the base of a hill. Toeslopes in profile are gentle, planar, and are constructed by deposition of materials from upslope sites of geologic erosion.

Topography. The relative position and elevations of the natural or manmade features of an area that describe the configuration of its surface.

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.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Triassic. The first period of the Mesozoic Era of geologic time (from approximately 230 to 195 million years ago).

Tuff-breccia. Igneous rock formed by explosive volcanic activity and consisting of more than 50 percent angular rock fragments consolidated with ash. It is commonly the dominant rock present in exposed volcanic necks.

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

Valley floor. A general term for the nearly level to gently sloping, bottom surface of a valley. Component landforms include axial stream channels, the flood plain, and in some areas, low stream terraces that may be subject to flooding from tributary streams. (See Wash, Flood plain, and Stream terrace)

Value. The degree of lightness or darkness of a color in relation to a neutral gray scale. (See Munsell notation)

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Volcanic neck. The solidified material which filled a vent or pipe of an extinct volcano.

Wash. The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

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.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Wind erosion equation. An equation first defined in the 1985 Food Security Act and used to calculate an erodibility index for highly erodible soil map unit determinations. The equation is climate factor (C) times wind erodibility index value (I) divided by soil loss tolerance factor (T).

Windthrow. The uprooting and tipping over of trees by the wind.

Tables

Santa Fe Area, New Mexico,
Tsankawi Part of
Bandelier National Monument
Table 1.--Recreational Development

01/18/2000

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
400: Canuela-----	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Slight	Severe: depth to rock
Rock Outcrop-----	---	---	---	---	---
Andanada-----	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Slight	Severe: depth to rock
Kayefes-----	Severe: depth to rock	Severe: depth to rock	Severe: slope depth to rock	Slight	Severe: depth to rock
401: Rock Outcrop-----	---	---	---	---	---
Abrojo-----	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Palatka-----	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope	Severe: slope depth to rock
402: Navajita-----	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope droughty
403: Piojillo-----	Moderate: slope too sandy	Moderate: slope too sandy	Severe: slope	Moderate: too sandy	Severe: droughty
404: Negrita-----	Severe: flooding	Slight	Moderate: slope small stones	Slight	Severe: droughty
Levante-----	Severe: flooding	Slight	Moderate: flooding slope small stones	Slight	Severe: droughty

Table 1. Recreation Development
(continued)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
405:					
Estante-----	Severe: slope small stones	Severe: slope small stones	Severe: slope small stones	Severe: slope	Severe: slope
Potente-----	Moderate: dusty small stones	Moderate: dusty small stones	Moderate: dusty cemented pan small stones	Moderate: dusty	Moderate: cemented pan
406:					
Rock Outcrop-----	---	---	---	---	---
Zacaton-----	Severe: large stones slope	Severe: large stones slope	Severe: large stones slope	Severe: slope	Severe: large stones slope
Palatka-----	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope	Severe: slope depth to rock

Santa Fe Area, New Mexico.
Tsankawi Part of
Bandelier National Monument
Table 2.--Wildlife Habitat

01/18/2000

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
400:												
Canuela-----	Very poor	Very poor	Fair	Fair	Poor	Fair	Poor	Very poor	Very poor	Very poor	Very poor	Fair
Rock Outcrop-----	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor
Andanada-----	Very poor	Very poor	Poor	Poor	Poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor
Kayefes-----	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Poor
401:												
Rock Outcrop-----	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor
Abrojo-----	Very poor	Very poor	Fair	Good	Good	Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair
Palatka-----	Very poor	Very poor	Fair	Fair	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Very poor	Fair
402:												
Navajita-----	Poor	Fair	Fair	Good	Good	Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair
403:												
Piojillo-----	Poor	Fair	Fair	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Very poor	Poor
404:												
Negrita-----	Very poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Poor
Levante-----	Very poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Poor
405:												
Estante-----	Very poor	Very poor	Fair	Good	Good	Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair
Potente-----	Poor	Fair	Fair	Poor	Poor	Fair	Poor	Very poor	Poor	Very poor	Very poor	Fair

Table 2.--Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
406:*												
Rock Outcrop-----	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor
Zacaton-----	Very poor	Very poor	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Very poor	Fair
Palatka-----	Very poor	Very poor	Fair	Fair	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Very poor	Fair

Very poor for
grasses;
fair to
very poor
for herbs

01/18/2000

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
400: Canuela-----	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock
Rock Outcrop-----	---	---	---	---	---	---
Andanada-----	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock
Kayefes-----	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock
401: Rock Outcrop-----	---	---	---	---	---	---
Abrojo-----	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Palatka-----	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock
402: Navajita-----	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action slope	Moderate: slope droughty
403: Piojillo-----	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: frost action slope	Severe: droughty
404: Negrita-----	Severe: cutbanks cave	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding	Severe: droughty
Levante-----	Severe: cutbanks cave	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding	Severe: droughty
405: Estante-----	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Potente-----	Severe: cemented pan	Moderate: cemented pan	Severe: cemented pan	Moderate: cemented pan	Moderate: frost action cemented pan	Moderate: cemented pan

Table 3.--Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
406: Rock Outcrop-----	---	---	---	---	---	---
Zacaton-----	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: large stones slope
Palatka-----	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock

Santa Fe Area, New Mexico.
Tsankawi Part of
Bandelier National Monument
Table 4.--Sanitary Facilities

01/18/2000

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
400: Canuela-----	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: thin layer depth to rock
Rock Outcrop-----	---	---	---	---	---
Andanada-----	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: thin layer depth to rock
Kayefes-----	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: thin layer depth to rock
401: Rock Outcrop-----	---	---	---	---	---
Abrojo-----	Severe: slope	Severe: seepage slope	Severe: seepage slope	Severe: seepage slope	Severe: slope
Palatka-----	Severe: slope depth to rock	Severe: seepage slope depth to rock	Severe: seepage slope depth to rock	Severe: seepage slope depth to rock	Severe: slope thin layer depth to rock
402: Navajita-----	Moderate: slope	Severe: seepage slope	Severe: seepage	Severe: seepage	Moderate: slope
403: Piojillo-----	Moderate: slope	Severe: seepage slope	Moderate: slope too sandy	Severe: seepage	Severe: seepage
404: Negrita-----	Severe: poor filter	Severe: seepage	Severe: too sandy	Moderate: flooding	Poor: seepage small stones too sandy
Levante-----	Severe: flooding poor filter	Severe: flooding seepage	Severe: flooding too sandy	Severe: flooding	Poor: seepage too sandy

Table 4.--Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
405:					
Estante-----	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Potente-----	Severe: cemented pan	Severe: cemented pan	Severe: seepage	Severe: cemented pan seepage	Severe: cemented pan seepage
406:					
Rock Outcrop-----	---	---	---	---	---
Zacaton-----	Severe: slope	Severe: slope	Severe: seepage slope	Severe: slope	Severe: slope
Palatka-----	Severe: slope depth to rock	Severe: seepage slope depth to rock	Severe: seepage slope depth to rock	Severe: seepage slope depth to rock	Severe: slope thin layer depth to rock

Santa Fe Area, New Mexico,
Tsankawi Part of
Bandelier National Monument
Table 5.--Construction Materials

01/18/2000

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
400: Canuela-----	Poor: depth to rock	Improbable: thin layer excess fines	Improbable: thin layer excess fines	Poor: thin layer depth to rock
Rock Outcrop-----	---	---	---	---
Andanada-----	Poor: thin layer depth to rock	Probable	Probable	Poor: thin layer depth to rock
Kayefes-----	Poor: thin layer depth to rock	Improbable: thin layer excess fines	Improbable: thin layer excess fines	Poor: thin layer depth to rock
401: Rock Outcrop-----	---	---	---	---
Abrojo-----	Poor: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Palatka-----	Poor: slope thin layer depth to rock	Improbable: thin layer excess fines	Improbable: thin layer excess fines	Poor: slope thin layer depth to rock
402: Navajita-----	Good	Improbable: excess fines	Improbable: excess fines	Fair: slope
403: Piojillo-----	Good	Probable	Probable	Fair: slope small stones too sandy
404: Negrita-----	Good	Probable	Probable	Poor: area reclaim small stones too sandy
Levante-----	Good	Improbable: thin layer	Improbable: thin layer	Poor: small stones too sandy

Table 5.--Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
405:				
Estante-----	Poor: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Potente-----	Poor: cemented pan	Improbable: small stones thin layer	Improbable: thin layer too sandy	Fair: cemented pan large stones small stones thin layer
406:				
Rock Outcrop-----	---	---	---	---
Zacaton-----	Poor: slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Palatka-----	Poor: slope thin layer depth to rock	Improbable: thin layer excess fines	Improbable: thin layer excess fines	Poor: slope thin layer depth to rock

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(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
400: Canuela-----	Severe: depth to rock	Severe: piping	Severe: depth to rock	Limitation: slope depth to rock	Limitation: slope soil blowing droughty	Limitation: soil blowing depth to rock	Limitation: depth to rock droughty
Rock Outcrop-----	---	---	---	---	---	---	---
Andanada-----	Severe: depth to rock	Severe: seepage	Severe: depth to rock	Limitation: slope depth to rock	Limitation: slope soil blowing depth to rock droughty	Limitation: soil blowing depth to rock	Limitation: depth to rock droughty
Kayefes-----	Severe: seepage slope depth to rock	Severe: piping	Severe: depth to rock	Limitation: slope depth to rock	Limitation: slope depth to rock droughty	Limitation: slope depth to rock	Limitation: slope depth to rock droughty
401: Rock Outcrop-----	---	---	---	---	---	---	---
Abrojo-----	Severe: seepage slope	Severe: piping	Slight	Limitation: slope	Limitation: slope droughty	Limitation: slope	Limitation: slope droughty
Palatka-----	Severe: seepage slope depth to rock	Severe: thin layer	Severe: depth to rock	Limitation: slope depth to rock	Limitation: slope depth to rock droughty	Limitation: slope depth to rock	Limitation: slope depth to rock droughty
402: Navajita-----	Severe: seepage slope	Severe: piping	Slight	Limitation: slope	Limitation: slope soil blowing droughty	Limitation: slope soil blowing	Limitation: slope droughty
403: Piojillo-----	Severe: seepage slope	Severe: seepage	Slight	Limitation: slope	Limitation: slope soil blowing droughty	Limitation: slope soil blowing	Limitation: slope droughty

Table 6.--Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
404: Negrita-----	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: soil blowing droughty	Limitation: too sandy soil blowing	Limitation: too arid droughty
Levante-----	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: fast intake soil blowing droughty	Limitation: too sandy soil blowing	Limitation: too arid droughty
405: Estante-----	Severe: seepage slope	Severe: piping	Slight	Limitation: slope	Limitation: slope droughty	Limitation: slope	Limitation: slope droughty
Potente-----	Severe: seepage	Severe: seepage thin layer	Severe: depth to rock	Limitation: slope depth to rock	Limitation: slope droughty	Limitation: depth to rock	Limitation: depth to rock droughty
406: Rock Outcrop-----	---	---	---	---	---	---	---
Zacaton-----	Severe: seepage slope	Moderate: large stones seepage piping	Slight	Limitation: slope	Limitation: slope droughty	Limitation: slope	Limitation: slope droughty
Palatka-----	Severe: seepage slope depth to rock	Severe: thin layer	Severe: depth to rock	Limitation: slope depth to rock	Limitation: slope depth to rock droughty	Limitation: slope depth to rock	Limitation: slope depth to rock droughty

01/18/2000

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

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
					Pct	Pct						
	In										Pct	
400:												
Canuela-----	0-2	Sandy loam	SC-SM, SM	A-2, A-4	0	0	85-95	80-90	55-65	40-50	20-25	NP-5
	2-7	Loam	CL-ML, CL	A-4	0	0	90-100	85-95	65-75	55-65	25-30	5-10
	7-16	Extremely paracobbly loam	CL-ML, CL	A-4	0	0	90-100	90-100	80-90	70-80	25-30	5-10
Rock Outcrop----	---	---	---	---	---	---	---	---	---	---	---	---
Andanada-----	0-2	Gravelly sandy loam	SC-SM, GM, SM, GC-GM	A-2, A-1	0	0	70-80	55-65	35-45	20-30	20-25	NP-5
	2-5	Very gravelly sandy loam	GP-GM, GM, GW-GM, GC-GM	A-1	0	0	45-55	30-40	20-30	10-20	20-25	NP-5
Kayefes-----	2-4	Sandy loam	SC-SM, SM	A-4, A-2	0	0	100	100	60-70	30-40	15-20	NP-5
	4-6	Sandy loam	SC-SM, SM	A-4, A-2	0	0	90-100	80-90	55-65	30-40	15-20	NP-5
	6-8	Extremely paracobbly sandy loam	SC-SM, SM	A-4, A-2	0	45-55	85-95	80-90	50-60	20-30	20-25	5-10
	8-11	Sandy loam	SC-SM, SM	A-4, A-2	0	0	100	100	60-70	35-45	20-25	NP-5
401:												
Rock Outcrop----	---	---	---	---	---	---	---	---	---	---	---	---
Abrojo-----	0-2	Extremely cobbly loamy coarse sand	SM, SP-SM, GW, SW-SM, SP, SW, GM, GP-GM, GW- GM, GP	A-1	20-30	25-45	65-75	50-60	20-30	15-25	15-20	NP
	2-9	Very gravelly loamy coarse sand	SW-SM, SP, SW, SP-SM, GP-GM, GW, GW-GM, GP	A-1	0	10-20	45-55	40-50	20-30	15-25	15-20	NP
	9-23	Very gravelly loamy coarse sand	SW-SM, SP, SW, SP-SM, GW-GM, GW, GP	A-1	5-15	10-20	45-55	35-45	20-30	15-25	15-20	NP
	23-30	Gravelly loamy coarse sand	SM, SP-SM, SW-SM	A-1	0	5-15	70-80	60-70	30-40	10-20	15-20	NP
	30-64	Sandy loam	SC-SM, SM	A-4, A-2	0	0	100	100	60-70	30-40	15-20	NP-5
	64-80	Gravelly loamy coarse sand	SM, SP-SM, SW-SM	A-1	0	0	70-80	55-65	20-30	10-15	15-20	NP
Palatka-----	1-2	Sandy loam	SC-SM, SM	A-4, A-2	0	0	100	90-100	60-70	35-45	20-25	NP-5
	2-5	Sandy loam	SC-SM, SM	A-4, A-2	0	0	90-100	80-90	55-65	30-40	20-25	NP-5
	5-7	Gravelly sandy loam	SM, GC-GM, SC-SM, GM	A-2, A-1	0	0	70-80	55-65	40-50	20-30	20-25	NP-5
402:												
Navajita-----	0-3	Sandy loam	SC-SM, SM	A-4, A-2	0	0	100	100	60-70	30-40	20-25	NP-5
	3-15	Sandy loam	SC-SM, SM	A-4, A-2	0	0	100	100	60-70	30-40	20-25	NP-5
	15-25	Sandy loam	SC-SM, SM	A-4, A-2	0	0	90-100	80-90	55-65	30-40	20-25	NP-5
	25-38	Sandy loam	SC-SM, SM	A-4, A-2	0	0	90-100	80-90	55-65	30-40	20-25	NP-5
	38-51	Sandy loam	SM, SC-SM	A-4, A-2	0	0	95-100	85-95	60-70	35-45	20-25	NP-5
	51-62	Sandy clay loam	CL, CL-ML, SC, SC-SM	A-4, A-2	0	0	95-100	85-95	65-75	40-50	25-30	5-10
	62-81	Sandy clay loam	CL-ML, SC-SM, CL, SC	A-4, A-2	0	0	95-100	85-95	65-75	40-50	25-30	5-10

Table 7.--Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
403: Piojillo-----	In				Pct	Pct					Pct	
	0-3	Gravelly loamy coarse sand	SM, SW-SM, SP-SM	A-1	0	0	70-80	60-70	30-40	20-30	0-15	NP
	3-6	Gravelly loamy coarse sand	SM, SP-SM, SW-SM	A-1	0	0	70-80	60-70	40-50	20-30	0-15	NP
	6-10	Loamy coarse sand	SM, SW-SM, SP-SM	A-2, A-1	0	0	85-95	80-90	45-55	25-35	0-15	NP
	10-21	Loamy coarse sand	SM, SW-SM, SP-SM	A-2, A-1	0	0	85-95	80-90	45-55	25-35	0-15	NP
	21-35	Gravelly loamy coarse sand	SM, SP-SM, SW-SM	A-1	0	0	70-80	65-75	40-50	20-30	0-15	NP
	35-84	Gravelly loamy coarse sand	SM, SW-SM, SP-SM	A-1	0	0	70-80	65-75	30-40	20-30	0-15	5-10
	84-110	Gravelly loamy coarse sand	SM, SP-SM, SW-SM	A-1	0	0	70-80	65-75	40-50	20-30	0-15	NP
404: Negrita-----	0-3	Sandy loam	SC-SM	A-2	0	0	80-95	75-90	35-50	15-30	20-25	5-10
	3-10	Gravelly coarse sandy loam, sandy loam, gravelly loamy coarse sand	SC-SM, SM	A-1, A-2	0	0	70-95	60-85	30-50	10-25	15-25	NP-10
	10-14	Stratified gravelly coarse sandy loam to gravelly coarse sand	SM	A-1	0	0	65-85	55-75	30-50	10-25	---	NP
	14-85	Stratified gravelly loamy coarse sand to very gravelly coarse sand	SM, SP-SM	A-1	0	0	55-70	45-60	20-35	5-20	---	NP
	85-99	Stratified sandy loam to gravelly loamy coarse sand	SC-SM, SM	A-1, A-2	0	0	65-90	60-85	25-45	10-25	15-25	NP-10
Levante-----	0-4	Loamy sand	SM	A-1	0	0	85-100	75-90	35-50	15-25	---	NP
	4-17	Stratified coarse sand to sandy loam	SM	A-1	0	0	85-100	75-90	30-45	10-25	---	NP
	17-45	Stratified gravelly loamy coarse sand to gravelly coarse sand	SM, SP-SM	A-1	0	0	65-85	55-75	20-40	5-20	---	NP
	45-58	Stratified gravelly coarse sandy loam to gravelly coarse sand	SM, SP-SM	A-1	0	0	60-80	50-70	30-50	5-25	---	NP
	58-99	Stratified coarse sandy loam to very gravelly coarse sand	GM, SM	A-1, A-2	0	0	50-70	40-60	30-45	15-30	---	NP

Table 7.--Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
405: Estante-----	0-3	Extremely gravelly coarse sandy loam	GW-GM, GP-GM, GP, GW	A-1	5-15	10-20	20-30	15-25	5-15	0-10	20-25	NP-5
	3-6	Very gravelly sandy clay loam	GC-GM, GC, GP-GC, GW-GC	A-2, A-1	0	5-15	45-55	40-50	25-35	20-30	25-30	5-10
	6-11	Very gravelly sandy clay loam	GC-GM, GC, GP-GC, GW-GC	A-1, A-2	0	5-15	45-55	40-50	20-30	15-25	25-30	5-10
	11-16	Very gravelly coarse sandy loam	GC-GM, GM, GW, GP-GM, GW-GM, GP	A-1	0	15-25	45-55	40-50	15-25	5-15	20-25	NP-5
	16-23	Loam	CL-ML, CL	A-4	0	0	100	100	85-95	65-75	25-30	5-10
	23-44	Loam	CL-ML, CL	A-4	0	0	100	100	85-95	65-75	25-30	5-10
	44-60	Loam	CL-ML, ML	A-4	0	0	100	100	85-95	65-75	20-25	NP-5
Potente-----	0-3	Gravelly loam	GC, SC-SM, SC, GC-GM, CL, CL-ML	A-4	0	5-15	60-70	55-65	40-50	30-40	18-25	5-10
	3-6	Clay loam	CL	A-6	0	0	85-95	80-90	60-70	50-60	35-45	20-25
	6-9	Clay loam	CL	A-6	0	0	85-95	80-90	60-70	50-60	35-45	15-20
	9-13	Gravelly loam	ML, CL-ML, SC-SM, GM, SM, GC-GM	A-4	0	0	70-80	65-75	45-55	40-50	20-30	5-10
	13-17	Gravelly sandy loam	SC-SM, GM, SM, GC-GM	A-2, A-1	0	5-15	60-70	55-65	40-50	20-30	15-25	5-10
	17-22	Very gravelly loamy coarse sand	SW, GP-GM, GW-GM, SP, GP, SW-SM, GW, SP-SM	A-1	0	10-20	55-65	50-60	20-30	10-20	10-20	NP
	22-26	Very gravelly coarse sand	SP, GW, SW, GP	A-1	0	25-35	70-80	65-75	30-40	10-20	5-15	NP
406: Rock Outcrop----	---	---	---	---	---	---	---	---	---	---	---	---
Zacaton-----	>1	Very cobbly sandy loam	SM, SC-SM, GC-GM, GM	A-2, A-1	10-20	25-35	70-80	65-75	50-60	25-35	15-25	NP-5
	>3	Cobbly sandy loam	SC-SM, SM	A-2	5-10	10-20	80-90	70-80	50-60	25-35	15-25	NP-5
	>9	Gravelly sandy loam	SC-SM, SM, GM, GC-GM	A-1, A-2	0	5-15	70-80	65-75	40-50	20-30	15-25	NP-5
	>18	Very cobbly loam	ML, SC-SM, CL-ML, SM, GM, GC-GM	A-4, A-2	10-20	20-30	75-85	70-80	60-70	45-55	15-25	NP-5
	>32	Gravelly sandy loam	SC-SM, GM, SM, GC-GM	A-2, A-1	0	5-15	70-80	60-70	40-50	20-30	15-25	NP-5
	48-63	Gravelly sandy loam	SM, SC-SM, GC-GM, GM	A-2, A-1	0	5-15	70-80	60-70	40-50	20-30	15-25	NP-5
	63-76	Gravelly loamy coarse sand	SP-SM, SM, SW-SM	A-1	0	0	60-70	55-65	20-30	10-15	15-25	NP
	76-102	Gravelly loamy coarse sand	SM, SP-SM, SW-SM	A-1	0	0	60-70	50-60	20-30	10-15	15-25	NP
Palatka-----	1-2	Sandy loam	SC-SM, SM	A-4, A-2	0	0	100	90-100	60-70	35-45	20-25	NP-5
	2-5	Sandy loam	SC-SM, SM	A-4, A-2	0	0	90-100	80-90	55-65	30-40	20-25	NP-5
	5-7	Gravelly sandy loam	SM, SC-SM, GC-GM, GM	A-2, A-1	0	0	70-80	55-65	40-50	20-30	20-25	NP-5

Santa Fe Area, New Mexico,
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Table 8.--Physical Properties of the Soils

01/18/2000

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer. Absence of an entry indicates that data were not estimated.)

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
										Kw	Kf	T		
	In	Pct	Pct	Pct	g/cc	In/hr	In/in	Pct	Pct					
400: Canuela-----	0-2	---	---	8-18	1.35-1.50	0.3-0.9	0.08-0.09	0.0-2.9	1.0-2.0	.17	.24	1	3	86
	2-7	---	---	18-27	1.25-1.40	0.09-0.3	0.13-0.15	3.0-5.9	0.5-1.0	.32	.37			
	7-16	---	---	18-27	1.25-1.40	0.09-0.3	0.03-0.03	0.0-2.9	0.5-1.0	.37	.37			
Rock Outcrop-----	---	---	---	---	---	---	---	---	---	---	---	-	---	---
Andanada-----	0-2	---	---	8-18	1.35-1.50	0.3-0.9	0.06-0.08	0.0-2.9	1.0-2.0	.10	.24	1	3	86
	2-5	---	---	8-18	1.35-1.50	0.3-0.9	0.05-0.06	0.0-2.9	0.5-1.0	.05	.24			
Kayefes-----	2-4	---	---	8-18	1.35-1.50	0.3-0.9	0.09-0.11	0.0-2.9	1.0-2.0	.24	.24	1	8	0
	4-6	---	---	8-18	1.35-1.50	0.3-0.9	0.08-0.10	0.0-2.9	0.5-1.0	.17	.24			
	6-8	---	---	8-18	1.35-1.50	0.3-0.9	0.03-0.03	0.0-2.9	0.5-1.0	.05	.24			
	8-11	---	---	8-18	1.35-1.50	0.3-0.9	0.09-0.11	0.0-2.9	0.5-1.0	.20	.24			
401: Rock Outcrop-----	---	---	---	---	---	---	---	---	---	---	---	-	---	---
Abrojo-----	0-2	---	---	4-8	1.45-1.60	0.9-3	0.01-0.02	0.0-2.9	1.0-2.0	.02	.15	5	8	0
	2-9	---	---	4-8	1.45-1.60	0.9-3	0.03-0.04	0.0-2.9	0.5-1.0	.05	.15			
	9-23	---	---	4-8	1.45-1.60	0.9-3	0.03-0.04	0.0-2.9	0.5-1.0	.05	.15			
	23-30	---	---	4-8	1.45-1.60	0.9-3	0.04-0.06	0.0-2.9	0.5-1.0	.10	.15			
	30-64	---	---	8-18	1.45-1.60	0.3-0.9	0.09-0.11	0.0-2.9	0.5-1.0	.24	.24			
	64-80	---	---	4-8	1.35-1.50	0.9-3	---	0.0-2.9	0.5-1.0	.10	.15			
Palatka-----	1-2	---	---	8-18	1.35-1.50	0.3-0.9	0.09-0.11	0.0-2.9	1.0-2.0	.20	.24	1	8	0
	2-5	---	---	8-18	1.35-1.50	0.3-0.9	0.08-0.10	0.0-2.9	0.5-1.0	.17	.24			
	5-7	---	---	8-18	1.35-1.50	0.3-0.9	0.07-0.08	0.0-2.9	0.5-1.0	.15	.24			
402: Navajita-----	0-3	---	---	8-18	1.35-1.50	0.3-0.9	0.09-0.11	0.0-2.9	1.0-2.0	.24	.24	5	3	86
	3-15	---	---	8-18	1.35-1.50	0.3-0.9	0.09-0.11	0.0-2.9	0.5-1.0	.24	.24			
	15-25	---	---	8-18	1.35-1.50	0.3-0.9	0.08-0.10	0.0-2.9	0.5-1.0	.17	.24			
	25-38	---	---	8-18	1.35-1.50	0.3-0.9	0.08-0.10	0.0-2.9	0.5-1.0	.17	.24			
	38-51	---	---	8-18	1.35-1.50	0.3-0.9	0.09-0.11	0.0-2.9	0.5-1.0	.20	.24			
	51-62	---	---	20-27	1.25-1.40	0.09-0.3	0.15-0.17	0.0-2.9	0.5-1.0	.28	.32			
	62-81	---	---	20-27	1.25-1.40	0.09-0.3	0.15-0.17	0.0-2.9	0.5-1.0	.28	.32			
403: Piojillo-----	0-3	---	---	4-8	1.45-1.60	0.9-3	0.04-0.06	0.0-2.9	1.0-2.0	.10	.15	5	2	134
	3-6	---	---	4-8	1.45-1.60	0.9-3	0.04-0.06	0.0-2.9	0.5-1.0	.10	.15			
	6-10	---	---	4-8	1.45-1.60	0.9-3	0.05-0.06	0.0-2.9	0.5-1.0	.10	.15			
	10-21	---	---	4-8	1.45-1.60	0.9-3	0.05-0.06	0.0-2.9	0.5-1.0	.10	.15			
	21-35	---	---	4-8	1.45-1.60	0.9-3	0.04-0.06	0.0-2.9	0.5-1.0	.10	.15			
	35-84	---	---	4-8	1.45-1.60	0.9-3	0.04-0.06	0.0-2.9	0.5-1.0	.10	.15			
	84-110	---	---	4-8	1.45-1.60	0.9-3	0.04-0.06	0.0-2.9	0.5-1.0	.10	.15			
404: Negrita-----	0-3	---	---	10-18	1.35-1.45	2-6	0.08-0.10	0.0-2.9	1.0-3.0	.20	.24	3	3	86
	3-10	---	---	6-18	1.35-1.45	2-6	0.05-0.09	0.0-2.9	1.0-3.0	.15	.20			
	10-14	---	---	4-10	1.40-1.50	6-20	0.04-0.08	0.0-2.9	0.8-2.0	.10	.15			
	14-85	---	---	0-6	1.40-1.50	20-60	0.02-0.05	0.0-2.9	0.4-0.8	.05	.10			
	85-99	---	---	6-18	1.40-1.50	2-20	0.05-0.09	0.0-2.9	0.6-2.0	.15	.20			
Levante-----	0-4	---	---	2-8	1.55-1.65	6-20	0.05-0.08	0.0-2.9	0.5-1.0	.17	.17	5	2	134
	4-17	---	---	0-8	1.45-1.55	2-20	0.04-0.08	0.0-2.9	0.2-0.8	.15	.15			
	17-45	---	---	0-8	1.50-1.60	6-20	0.03-0.05	0.0-2.9	0.2-0.5	.10	.15			
	45-58	---	---	0-8	1.50-1.60	6-60	0.03-0.05	0.0-2.9	0.1-0.5	.10	.15			
	58-99	---	---	2-8	1.45-1.55	2-60	0.02-0.04	0.0-2.9	0.2-1.0	.05	.15			

Table 8.--Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Permea- bility (Ksat)	Available water capacity	Linear extensi- bility	Organic matter	Erosion factors			Wind erodi- bility group	Wind erodi- bility index
										Kw	Kf	T		
405:	In	Pct	Pct	Pct	g/cc	In/hr	In/in	Pct	Pct					
Estante-----	0-3	---	---	8-18	1.35-1.50	0.3-0.9	0.02-0.03	0.0-2.9	1.0-2.0	.02	.20	5	8	0
	3-6	---	---	18-27	1.25-1.40	0.09-0.3	0.10-0.11	3.0-5.9	0.5-1.0	.10	.32			
	6-11	---	---	18-27	1.25-1.40	0.09-0.3	0.08-0.09	3.0-5.9	0.5-1.0	.10	.32			
	11-16	---	---	8-18	1.35-1.50	0.3-0.9	0.04-0.06	0.0-2.9	0.5-1.0	.05	.20			
	16-23	---	---	18-27	1.25-1.40	0.09-0.3	0.14-0.16	0.0-2.9	0.5-1.0	.37	.37			
	23-44	---	---	18-27	1.25-1.40	0.09-0.3	0.14-0.16	0.0-2.9	0.5-1.0	.37	.37			
	44-60	---	---	8-18	1.25-1.40	0.09-0.3	0.14-0.16	0.0-2.9	0.5-1.0	.37	.37			
Potente-----	0-3	---	---	10-20	1.25-1.40	0.09-0.9	0.10-0.11	0.0-2.5	1.0-2.0	.17	.37	2	5	56
	3-6	---	---	35-45	1.25-1.40	0.01-0.09	0.16-0.18	3.0-5.9	0.5-1.0	.24	.32			
	6-9	---	---	18-35	1.25-1.40	0.03-0.09	0.16-0.18	3.0-5.9	0.5-1.0	.24	.32			
	9-13	---	---	15-20	1.25-1.40	0.09-0.9	0.11-0.13	0.0-2.9	0.5-1.0	.17	.37			
	13-17	---	---	5-15	1.35-1.50	0.3-0.9	0.06-0.08	0.0-2.9	0.5-1.0	.10	.24			
	17-22	---	---	4-8	1.45-1.60	0.9-3	0.03-0.04	0.0-2.9	0.5-1.0	.05	.15			
	22-26	---	---	0-4	1.45-1.60	3-3	0.02-0.04	0.0-2.9	0.5-1.0	.05	.10			
406:														
Rock Outcrop-----	---	---	---	---	---	---	---	---	---	---	---	-	---	---
Zacaton-----	>1	---	---	8-18	1.35-1.50	0.3-0.9	0.04-0.05	0.0-2.9	1.0-2.0	.05	.24	5	8	0
	>3	---	---	8-18	1.35-1.50	0.3-0.9	0.06-0.08	0.0-2.9	0.5-1.0	.10	.24			
	>9	---	---	8-18	1.35-1.50	0.3-0.9	0.06-0.08	0.0-2.9	0.5-1.0	.10	.24			
	>18	---	---	10-20	1.25-1.40	0.09-0.3	0.08-0.10	0.0-2.9	0.5-1.0	.15	.37			
	>32	---	---	8-18	1.35-1.50	0.3-0.9	0.07-0.09	0.0-2.9	0.5-1.0	.15	.24			
	48-63	---	---	8-18	1.35-1.50	0.3-0.9	0.07-0.09	0.0-2.9	0.5-1.0	.15	.24			
	63-76	---	---	4-8	1.45-1.60	0.9-3	0.04-0.05	0.0-2.9	0.5-1.0	.10	.15			
	76-102	---	---	4-8	1.45-1.60	0.9-3	0.04-0.05	0.0-2.9	0.5-1.0	.10	.15			
Palatka-----	1-2	---	---	8-18	1.35-1.50	0.3-0.9	0.09-0.11	0.0-2.9	1.0-2.0	.20	.24	1	8	0
	2-5	---	---	8-18	1.35-1.50	0.3-0.9	0.08-0.10	0.0-2.9	0.5-1.0	.17	.24			
	5-7	---	---	8-18	1.35-1.50	0.3-0.9	0.07-0.08	0.0-2.9	0.5-1.0	.15	.24			

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Table 9.--Chemical Properties of the Soils

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

Map symbol and soil name	Depth	Cation exchange capacity	Effective cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
400:								
Canuela-----	0-2	5.0-15	---	7.4-7.8	0	0	0.0-2.0	0-1
	2-7	10-20	---	7.4-7.8	0	0	0.0-2.0	0-1
	7-16	10-20	---	7.9-8.4	3-5	0	0.0-2.0	0-1
Rock Outcrop-----	---	---	---	---	---	---	---	---
Andanada-----	0-2	5.0-15	---	7.9-8.4	0	0	0.0-2.0	0-1
	2-5	4.0-15	---	7.9-8.4	3-5	0	0.0-2.0	0-1
Kayefes-----	2-4	5.0-15	---	7.9-8.4	0	0	0.0-2.0	0-1
	4-6	4.0-15	---	7.9-8.4	1-5	0	0.0-2.0	0-1
	6-8	4.0-15	---	7.4-7.8	3-5	0	0.0-2.0	0-1
	8-11	4.0-10	---	8.5-9.0	5-15	0	0.0-2.0	0-1
401:								
Rock Outcrop-----	---	---	---	---	---	---	---	---
Abrojo-----	0-2	4.0-10	---	6.6-7.3	0	0	0.0-2.0	0-1
	2-9	3.0-5.0	---	7.4-7.8	0	0	0.0-2.0	0-1
	9-23	3.0-5.0	---	7.9-8.4	0	0	0.0-2.0	0-1
	23-30	3.0-5.0	---	7.9-8.4	0	0	0.0-2.0	0-1
	30-64	4.0-15	---	7.4-7.8	0	0	0.0-2.0	0-1
	64-80	3.0-5.0	---	7.4-7.8	0	0	0.0-2.0	0-1
Palatka-----	1-2	5.0-15	---	6.6-7.3	0	0	0.0-2.0	0-1
	2-5	4.0-15	---	6.6-7.3	0	0	0.0-2.0	0-1
	5-7	4.0-15	---	6.6-7.3	0	0	0.0-2.0	0-1
402:								
Navajita-----	0-3	5.0-15	---	6.6-7.3	0	0	0.0-2.0	0-1
	3-15	4.0-15	---	7.4-7.8	0	0	0.0-2.0	0-1
	15-25	4.0-15	---	7.4-7.8	0	0	0.0-2.0	0-1
	25-38	4.0-15	---	7.4-7.8	1-3	0	0.0-2.0	0-1
	38-51	4.0-15	---	7.9-8.4	3-5	0	0.0-2.0	0-1
	51-62	10-20	---	7.4-7.8	0	0	0.0-2.0	0-1
	62-81	10-20	---	7.9-8.4	1-3	0	0.0-2.0	0-1
403:								
Piojillo-----	0-3	4.0-10	---	6.6-7.3	0	0	0.0-2.0	0-1
	3-6	3.0-5.0	---	6.6-7.3	0	0	0.0-2.0	0-1
	6-10	3.0-5.0	---	6.6-7.3	0	0	0.0-2.0	0-1
	10-21	3.0-5.0	---	6.6-7.3	0	0	0.0-2.0	0-1
	21-35	3.0-5.0	---	6.6-7.3	0	0	0.0-2.0	0-1
	35-84	3.0-5.0	---	7.9-8.4	1-3	0	0.0-2.0	0-1
	84-110	3.0-5.0	---	7.9-8.4	1-3	0	0.0-2.0	0-1

Table 9.--Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation exchange capacity	Effective cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	meq/100 g	meq/100 g	pH	Pct	Pct	mmhos/cm	
404: Negrita-----	0-3	10-15	---	6.6-7.3	0	0	0.0-1.0	0-1
	3-10	5.0-15	---	6.6-7.3	0	0	0.0-1.0	0-1
	10-14	3.0-10	---	6.6-7.8	0-1	0	0.0-1.0	0-1
	14-85	1.0-1.0	---	6.6-7.8	0-1	0	0.0-1.0	0-1
	85-99	5.0-15	---	6.6-7.8	0-3	0	0.0-2.0	0-1
Levante-----	0-4	2.0-5.0	---	7.4-7.8	3-5	0	0.0-1.0	0-1
	4-17	0.0-1.0	---	7.4-8.4	3-10	0	0.0-1.0	0-1
	17-45	0.0-1.0	---	7.9-8.4	2-7	0	0.0-1.0	0-1
	45-58	0.0-1.0	---	7.9-8.4	1-3	0	0.0-1.0	0-1
	58-99	2.0-5.0	---	7.9-8.4	1-3	0	0.0-1.0	0-1
405: Estante-----	0-3	5.0-15	---	7.4-7.8	0	0	0.0-2.0	0-1
	3-6	10-20	---	7.4-7.8	0	0	0.0-2.0	0-1
	6-11	10-20	---	7.9-8.4	0	0	0.0-2.0	0-1
	11-16	4.0-15	---	7.9-8.4	0	0	0.0-2.0	0-1
	16-23	10-20	---	7.9-8.4	0	0	0.0-2.0	0-1
	23-44	10-20	---	7.9-8.4	0	0	0.0-2.0	0-1
	44-60	4.0-15	---	7.9-8.4	0	0	0.0-2.0	0-1
Potente-----	0-3	5.0-15	---	7.4-7.8	0	0	0.0-2.0	0-1
	3-6	15-25	---	7.4-7.8	0	0	0.0-2.0	0-1
	6-9	10-25	---	7.9-8.4	0	0	0.0-2.0	0-1
	9-13	5.0-10	---	7.9-8.4	25-35	0	0.0-2.0	0-1
	13-17	1.0-10	---	7.9-8.4	25-35	0	0.0-2.0	0-4
	17-22	2.0-5.0	---	7.9-8.4	10-20	0	0.0-2.0	0-1
	22-26	2.0-5.0	---	7.9-8.4	35-45	0	0.0-2.0	0-1
406: Rock Outcrop-----	---	---	---	---	---	---	---	---
Zacaton-----	>1	5.0-15	---	6.6-7.3	0	0	0.0-2.0	0-1
	>3	4.0-15	---	7.4-7.8	0	0	0.0-2.0	0-1
	>9	4.0-15	---	7.4-7.8	0-5	0	0.0-2.0	0-1
	>18	4.0-10	---	9.1-11.0	15-25	0	0.0-2.0	0-1
	>32	4.0-15	---	9.1-11.0	2-5	0	2.0-4.0	0-4
	48-63	4.0-15	---	9.1-11.0	2-5	0	0.0-2.0	0-1
	63-76	3.0-5.0	---	8.5-9.0	0-5	0	0.0-2.0	0-1
	76-102	3.0-5.0	---	8.5-9.0	0	0	0	0
Palatka-----	1-2	5.0-15	---	6.6-7.3	0	0	0.0-2.0	0-1
	2-5	4.0-15	---	6.6-7.3	0	0	0.0-2.0	0-1
	5-7	4.0-15	---	6.6-7.3	0	0	0.0-2.0	0-1

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Table 10.--Water Features

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(Depths of layers are in feet. See text for definitions of terms used in this table. Absence of an entry indicates that the feature is not a concern or that data were not estimated.)

Map symbol and soil name	Hydro- logic group	Month	Water table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
400: Canuela-----	C	All months	---	---	---	---	---	---	---
Rock Outcrop-----	---	All months	---	---	---	---	---	---	---
Andanada-----	D	All months	---	---	---	---	---	---	---
Kayefes-----	C	All months	---	---	---	---	---	---	---
401: Rock Outcrop-----	---	All months	---	---	---	---	---	---	---
Abrojo-----	A	All months	---	---	---	---	---	---	---
Palatka-----	C	All months	---	---	---	---	---	---	---
402: Navajita-----	B	All months	---	---	---	---	---	---	---
403: Piojillo-----	B	All months	---	---	---	---	---	---	---
404: Negrita-----	A	January All months	---	---	---	---	---	---	Rare ---
Levante-----	A	July August September	---	---	---	---	---	Very brief Very brief Very brief	Occasional Occasional Occasional
405: Estante-----	B	All months	---	---	---	---	---	---	---
Potente-----	C								

Table 10.--Water Features--Continued

Map symbol and soil name	Hydro- logic group	Month	Water table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
406: Rock Outcrop----- Zacaton----- Palatka-----	---	All months	---	---	---	---	---	---	---
		All months	---	---	---	---	---	---	---
		All months	---	---	---	---	---	---	---
		All months	---	---	---	---	---	---	---

(See text for definitions of terms used in this table. Absence of an entry indicates that the feature is not a concern or that data were not estimated.)

Map symbol and soil name	Restrictive layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
400:		In	In		In	In			
Canuela-----	Bedrock (lithic)	---	---	Very strongly cemented	0	---	Moderate	Moderate	Low
Rock Outcrop-----	Bedrock (lithic)	---	---	Indurated	---	---	---	---	---
Andanada-----	Bedrock (lithic)	---	---	Very strongly cemented	0	---	Moderate	Moderate	Low
Kayefes-----	Bedrock (lithic)	---	---	Very strongly cemented	0	---	Moderate	Moderate	Low
401:									
Rock Outcrop-----	Bedrock (lithic)	---	---	Indurated	---	---	---	---	---
Abrojo-----	---	---	---	---	0	---	Low	Moderate	Low
Palatka-----	Bedrock (lithic)	---	---	Very strongly cemented	0	---	Moderate	Moderate	Low
402:									
Navajita-----	---	---	---	---	0	---	Moderate	Moderate	Low
403:									
Piojillo-----	---	---	---	---	0	---	Moderate	Moderate	Low
404:									
Negrita-----	---	---	---	---	0	---	Low	High	Low
Levante-----	---	---	---	---	0	---	Low	Moderate	Low
405:									
Estante-----	---	---	---	---	0	---	Moderate	Moderate	Low
Potente-----	---	---	---	---	0	---	Moderate	High	Low
406:									
Rock Outcrop-----	Bedrock (lithic)	---	---	Indurated	---	---	---	---	---
Zacaton-----	---	---	---	---	0	---	Moderate	Moderate	Low
Palatka-----	Bedrock (lithic)	---	---	Very strongly cemented	0	---	Moderate	Moderate	Low

SANTA FE AREA, NEW MEXICO,
Tsankawi Part of
Bandelier National Monument
Table 12.--Classification of the Soils

01/18/2000

Soil name	Family or higher taxonomic class
Abrojo-----	Sandy, mixed, mesic Aridic Ustorthents
Andanada-----	Loamy-skeletal, mixed, superactive, calcareous, mesic Aridic Lithic Ustorthents
Canuela-----	Fine-loamy, mixed, superactive, mesic Lithic Haplustalfs
Estante-----	Loamy-skeletal, mixed, superactive, mesic Aridic Haplustalfs
Kayefes-----	Coarse-loamy, mixed, superactive, mesic Aridic Haplustepts
Levante-----	Sandy, mixed, mesic, Aridic Ustifluvents
Navajita-----	Coarse-loamy, mixed, superactive, mesic Aridic Haplustalfs
Negrita-----	Sandy, mixed, mesic Torrifluventic Hapustolls
Palatka-----	Coarse-loamy, mixed, superactive, nonacid, mesic Aridic Ustorthents
Piojillo-----	Mixed, mesic Aridic Ustipsamments
Potente-----	Coarse-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Petrocalcic Paleustalfs
Zacaton-----	Coarse-loamy, mixed, superactive, mesic Vitrandic Haplustepts

SOIL SURVEY

WATER

SURVEY

Tsankawj
Ruins

