United States
Department of
Agriculture

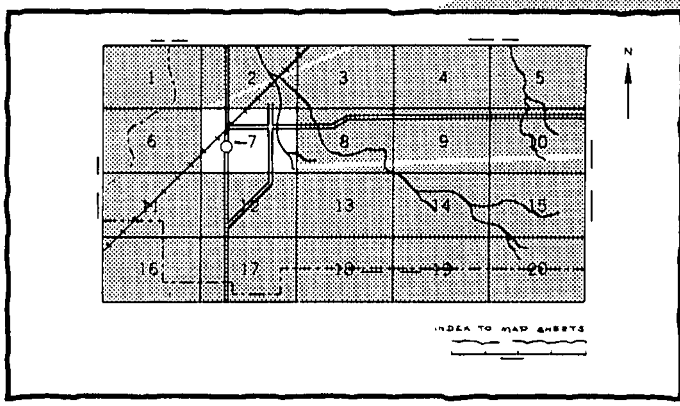
Soil
Conservation
Service

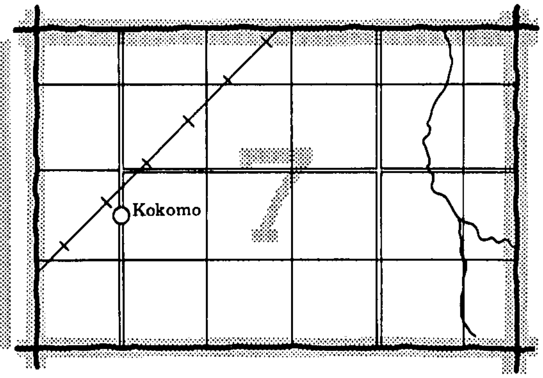
In cooperation with
The Regents of the
University of California
(Agricultural Experiment
Station)

Soil Survey of Sutter County, California

HOW TO USE

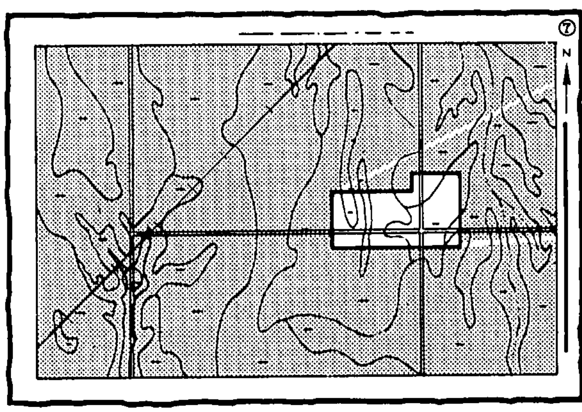
1. Locate your area of interest on the "Index to Map Sheets."

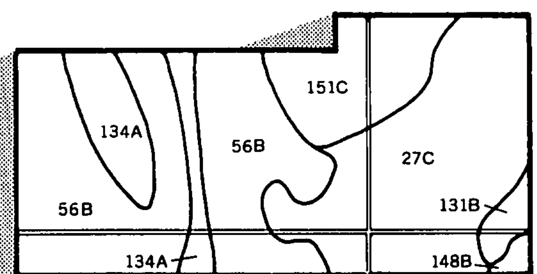




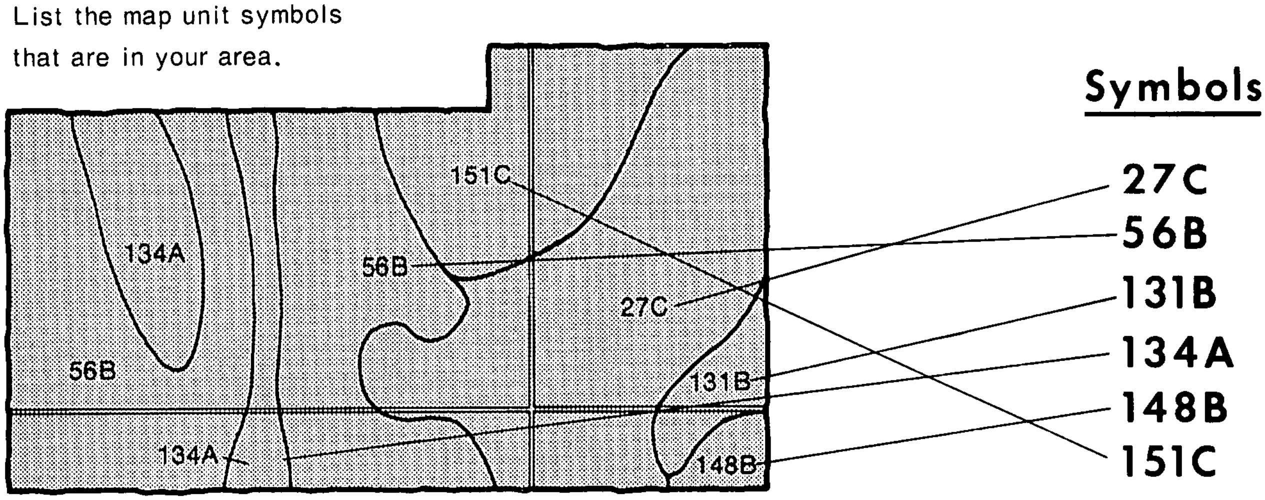
2. Note the number of the map sheet and turn to that sheet.

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



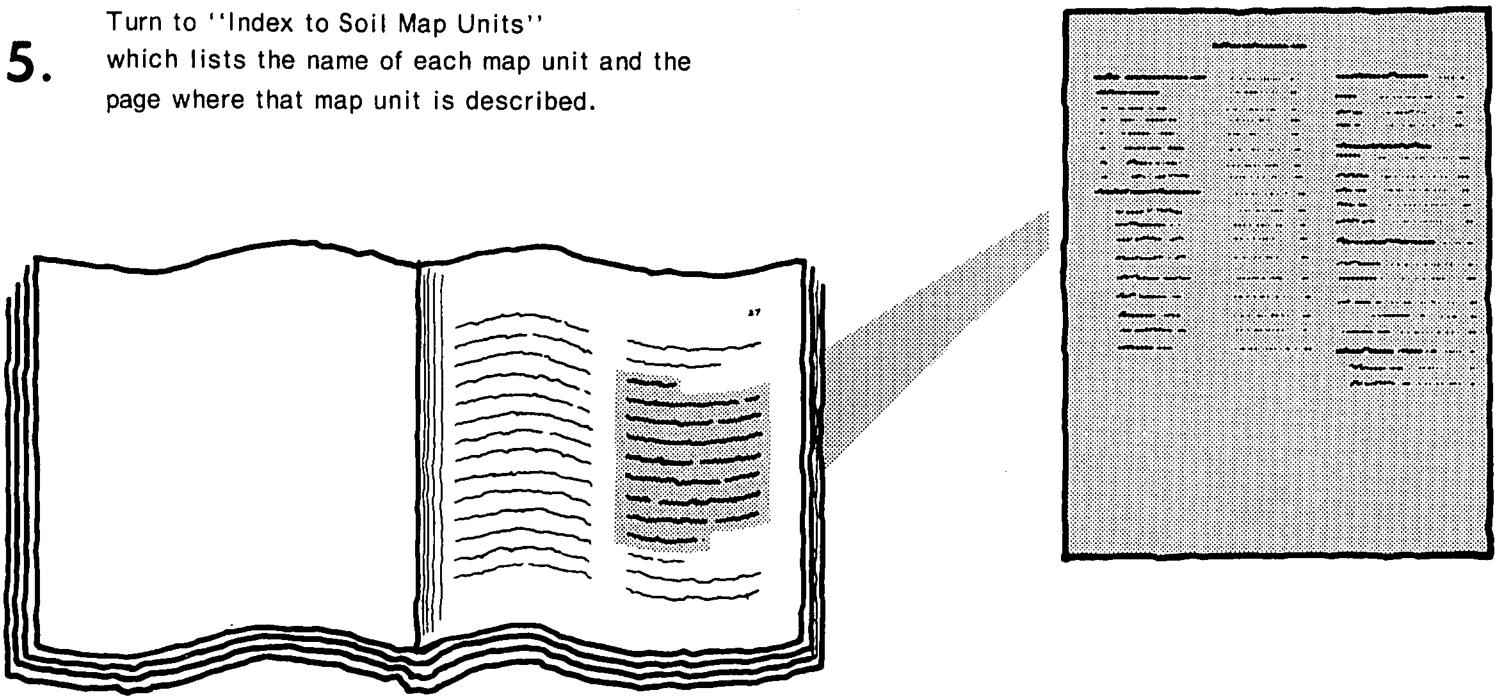


4. List the map unit symbols that are in your area.

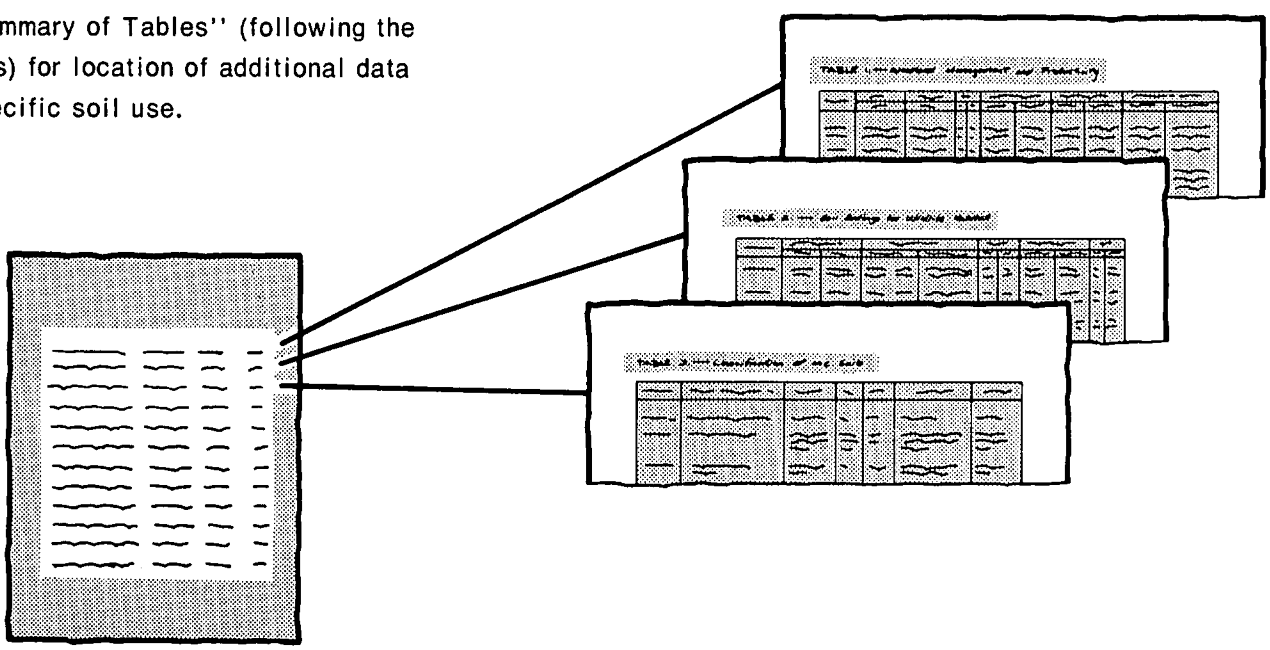


THIS SOIL SURVEY

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



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



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

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

Major fieldwork for this soil survey was completed in 1982. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1982. This survey was made cooperatively by the Soil Conservation Service and The Regents of the University of California (Agricultural Experiment Station). It is part of the technical assistance furnished to the Sutter County Resource Conservation District.

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

Cover: An aerial view of Sutter County looking east to west. The Feather River is in the foreground, lower right. Yuba City is in the foreground, and Sutter Buttes is in the background.

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Issued July 1988

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Summary of Tables

Foreword

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

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

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

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

Eugene E. Andreuccetti
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Location of Sutter County in California.

Soil Survey of Sutter County, California

By Dennis J. Lytle, Soil Conservation Service

Fieldwork by Robert G. Kurowski, Michael L. Whiting, Eric N. Vinson, Peter W. Vonich, Robert W. Hansen, and Dennis J. Lytle, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
in cooperation with
The Regents of the University of California
(Agricultural Experiment Station)

SUTTER COUNTY has a total area of 388,480 acres, or about 607 square miles. The survey area is bounded by the Sacramento River and Butte Creek on the west and by the Feather River and Yuba and Placer Counties on the east. Butte County forms the northern boundary, and Sacramento County forms the southern boundary.

Most of the soils in the survey area are used for agriculture. A few areas are used for urban development. Elevation ranges from 2,117 feet in the Sutter Buttes to about 10 feet near the southern boundary of the county.

Three older surveys have been published: Soil Survey of the Marysville Area, published in 1911 (*13*); Reconnaissance Soil Survey of Sacramento Valley, 1915 (*14*); Reconnaissance Soil Survey of Sutter County, 1965 (*6*). These earlier surveys cover a part of the present survey. The present survey, however, updates the earlier surveys and provides additional information and larger maps that show the soils in greater detail.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent survey areas. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey.

General Nature of the Survey Area

This section provides general information about the survey area. It discusses history and development; water supply; physiography, relief, and drainage; farming; and climate.

History and Development

Sutter County was first inhabited by Indians who lived in villages primarily adjacent to the Feather River and in and around the Sutter Buttes. The first white settlement, Hock Farm, was established by Captain John A. Sutter in the winter of 1841-42 (*4*). It was about 3 miles south of Yuba City, along the Feather River. In the early 1850's, wheat and barley were being grown extensively in the area. Settlement accelerated during the Gold Rush, and continuous cropping of wheat exhausted the soil (*13*). Eventually wheat production dropped, and by 1909 nonirrigated peaches, prunes, almonds, grapes, alfalfa, and hops were all being grown. Nonirrigated barley and wheat were also grown in the moister areas. Some water from the rivers was diverted in the late 1800's for irrigation, but the most rapid increase in the irrigated acreage occurred after 1910. Currently, most of the farmland is irrigated.

Water Supply

Precipitation, ground water, and diversion canals are the main sources of water in the survey area. Precipitation provides a substantial part of the water supply. Ground water generally is abundant and of excellent quality. Depth to ground water generally is 10 to 100 feet. The amount of ground water available in the southeastern part of the survey area is declining. Camp Far West Reservoir supplies some water for this area. Some wells in the basins, particularly in the Sutter Basin, have high concentrations of salt, mainly chlorine. Water is diverted from all the rivers in the area by canals or by pumps.

Physiography, Relief, and Drainage

Sutter County is in the east-central part of the Sacramento Valley. The Sacramento Valley forms the northern half of the central valley, which is surrounded on all sides by mountains, except where the Sacramento and San Joaquin Rivers enter San Francisco Bay.

The eastern part of the county is an alluvial terrace with elevations of 35 to 80 feet. This terrace generally drains to the southwest into the lower Sutter and American Basins, which are at 10 to 40 feet elevation. Drainage generally is provided by ditches and pumping plants that elevate the water over the levees of the Sacramento River.

The Sacramento River provides drainage for all of Sutter County and the Sacramento Valley through a system of levees and bypasses completed in the 1920's. In winter and spring, floodwater from various rivers and drainageways is controlled by this system. Excess water from the Sacramento River flows into Butte Basin and then into the Sutter Bypass, in the center of the county. Additional water is diverted from the Sacramento River through the Tisdale Bypass into the Sutter Bypass. Floodwater and water from the Feather and Bear Rivers rejoin the Sacramento River near Verona where, if necessary, they are diverted into the Yolo Bypass, in Yolo County. The final outlet of the water is the delta and San Francisco Bay.

Drainage for most of the survey area is adequate from late in spring to late in fall. The water table is below the rooting depth of most deep-rooted crops in all areas except for some small areas in the basin southeast of Meridian. During winter and spring the water table rises in the basins because of runoff and precipitation, and it rises in areas adjacent to levees because of seepage. During the flood stage of the rivers and bypasses, seepage through the levees raises the water table to near the soil surface in areas adjacent to the levees and crops commonly are damaged (*7*).

Farming

The survey area has an intensive and diversified farming industry because of a combination of good soil, a long growing season, and a plentiful supply of water for irrigation. About 320,000 acres is intensively used for fruit, nuts, grain, vegetables, and seed crops. More than 50 crops are grown commercially. Deep-rooted fruit and nut trees generally are grown on the fertile alluvial terrace in the northeastern part of the area. The basins are used mainly for rice, small grain, and vegetables.

Climate

The climate of Sutter County is characterized by hot, dry summers and cool, moist winters. The average annual precipitation ranges from about 15 inches in the extreme western part of the county to about 20 inches in the extreme eastern part. Snow is rare. Precipitation is heaviest in December through February, and it is lightest in June through September.

The average annual temperature is about 62 degrees F (table 1). The average temperature in July is about 79 degrees. During July and August, the maximum temperature frequently exceeds 100 degrees. The average temperature in January is about 46 degrees. Temperatures as high as 118 degrees and as low as 18 degrees have been recorded in Marysville (*19*).

The growing season, which is the interval between the last temperature of 32 degrees or lower in spring and the first in fall, varies greatly from year to year. The growing season is as short as 230 days and as long as 365 days, but it averages about 260 days in the western part of the survey area and increases to about 290 days (table 2) in the eastern part (*5*).

Wind direction is determined mainly by the flow of marine air through the Carquinez Strait and by the north-south orientation of the Sacramento Valley. The wind is dominantly from the south. In summer, the southerly winds generally are cool, but occasional northerly winds are hot and dry. These northerly winds quickly remove moisture from the soil surface and reduce the amount of moisture available for crops and trees.

In winter, when the wind velocity is low, the cold air drainage from the surrounding uplands and the relatively moist, warm soil cause fog to form, which may last from several days to several weeks.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey 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 into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils 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 or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, 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 considerable accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

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

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

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

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

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The soils or miscellaneous areas making up one unit can occur in other units but in a different pattern.

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

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

The general map units in this survey have been grouped into general kinds of landscape for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

Map Unit Descriptions

Soils on mountains, hills, and alluvial fans in the Sutter Buttes

Four map units are in this group. They make up about 15 percent of the survey area.

1. Ocraig-Palls-Bohna Variant

Very shallow, moderately deep, and very deep, steep to very steep, somewhat excessively drained and well drained very stony coarse sandy loam, stony sandy loam, and sandy loam over igneous rock; on mountains

This map unit is in the central part of the Sutter Buttes. The soils in this unit formed in moderately coarse textured residuum weathered from extrusive igneous rock and lahar.

This unit makes up about 2 percent of the survey area. It is about 30 percent Ocraig soils, 29 percent Palls soils, and 27 percent Bohna Variant soils. The remaining 14 percent is components of minor extent.

Ocraig soils are very shallow and somewhat excessively drained. Typically, the surface layer is neutral very stony coarse sandy loam. The underlying material is neutral very stony coarse sandy loam. Below this is andesite. Slope ranges from 30 to 75 percent.

Palls soils are moderately deep and well drained. Typically, the surface layer is medium acid stony sandy loam. The underlying material is neutral gravelly sandy loam. Below this is andesitic lahar or andesite. Slope ranges from 30 to 60 percent.

Bohna Variant soils are very deep and well drained. Typically, the surface layer is slightly acid sandy loam. The underlying material is slightly acid sandy clay loam. Slope ranges from 30 to 60 percent.

Of minor extent in this unit are shallow Stohlman soils and Rock outcrop.

This unit is used mainly as woodland, rangeland, watershed, and wildlife habitat. The main limitations are steepness of slope, hazard of erosion, stoniness, low available water capacity, and limited rooting depth.

2. Altamont-Dibble

Moderately deep and deep, rolling to steep, well drained silty clay and silty clay loam over sedimentary rock; on hills

This map unit is mainly in the Sutter Buttes. It also forms a thin boundary on the western and southern flanks of the central part of the Sutter Buttes. The soils in this unit formed in fine textured residuum weathered from sandstone and shale.

This unit makes up about 1 percent of the survey area. It is about 35 percent Altamont soils and 35 percent Dibble soils. The remaining 30 percent is components of minor extent.

Altamont soils are deep. Typically, the surface layer is neutral to moderately alkaline silty clay. The underlying material is moderately alkaline silty clay or silty clay loam. Below this is shale. Slope ranges from 9 to 50 percent.

Dibble soils are moderately deep. Typically, the surface layer is slightly acid to neutral silty clay loam. The underlying material is neutral clay. Below this is sandstone. Slope ranges from 9 to 50 percent.

Of minor extent in this unit are Olashes, Ocraig, Palls, Stohlman, and Capay soils.

This unit is used as rangeland. Grazing is limited by the clay texture of the soils and a hazard of water erosion.

3. Palls-Stohlman

Shallow and moderately deep, rolling to steep, well drained stony sandy loam over igneous rock; on hills

This map unit forms the outer part of the Sutter Buttes. The soils in this unit formed in coarse textured residuum weathered from lahar.

This unit makes up about 7 percent of the survey area. It is about 44 percent Palls soils and 44 percent Stohlman soils. The remaining 12 percent is components of minor extent.

Palls soils are moderately deep. Typically, the surface layer is medium acid stony sandy loam. The underlying material is neutral gravelly sandy loam. Below this is andesitic lahar. Slope ranges from 9 to 50 percent.

Stohlman soils are shallow. Typically, the surface layer is slightly acid stony sandy loam. The underlying material is slightly acid gravelly sandy loam. Below this is andesitic lahar. Slope ranges from 9 to 50 percent.

Of minor extent in this unit are Olashes, Capay, Ocraig, Altamont, and Dibble soils and Rock outcrop.

This unit is used mainly for livestock grazing and as woodland. The main limitations are slope, a hazard of water erosion, and stones on the surface.

4. Olashes

Very deep, nearly level to gently sloping, well drained sandy loam; on alluvial fans

This map unit occupies alluvial fans surrounding the Sutter Buttes. The soils in this unit formed in mixed alluvium derived mainly from andesite, lahar, and sandstone or shale.

This unit makes up about 5 percent of the survey area. It is 95 percent Olashes soils. The remaining 5 percent is components of minor extent.

Typically, Olashes soils have a surface layer of slightly acid sandy loam. The underlying material is slightly acid to mildly alkaline sandy clay loam. Slope ranges from 0 to 5 percent.

Of minor extent in the unit are Capay, Marcum, Palls, Stohlman, and Liveoak soils.

This unit is used mainly for irrigated orchard crops and small grain. The major crops grown are almonds, prunes, rice, and dry beans. A few areas of the unit are used for nonirrigated hay and homesite development.

This unit has few limitations for most crops commonly grown in the area.

Soils on terraces

Two map units are in this group. They make up about 25 percent of the survey area.

5. Conejo-Tisdale

Moderately deep to very deep, level to nearly level, well drained loam and clay loam; on terraces

This map unit is along the northeastern edge of the survey area. The soils in this unit formed in medium textured alluvium derived from mixed sources.

This unit makes up about 15 percent of the survey area. It is about 41 percent Conejo soils and 30 percent Tisdale soils. The remaining 29 percent is components of minor extent.

Conejo soils are deep to very deep. Typically, the surface layer is neutral loam. The subsoil is moderately alkaline loam. Below this is siltstone. Slope ranges from 0 to 2 percent.

Tisdale soils are moderately deep. Typically, the surface layer is mildly alkaline clay loam. The subsoil is moderately alkaline clay loam. Below this is siltstone. Slope ranges from 0 to 2 percent.

Of minor extent in this unit are Marcum, Liveoak, Gridley, Garretson Variant, and Oswald soils and Urban land.

This unit is used for irrigated orchards and cultivated crops. The major crops grown are walnuts, peaches, prunes, almonds, kiwis, tomatoes, dry beans, and melons. A few areas are used for nonirrigated small grain and homesite development.

The Conejo soils in this unit have few limitations for most crops commonly grown in the area. The Tisdale soils are limited mainly by restricted soil depth.

6. San Joaquin-Cometa

Moderately deep and very deep, level to nearly level, well drained sandy loam and loam; on terraces

This map unit is on the southeastern side of the survey area. The soils in this unit formed in alluvium derived from mixed sources, mainly granitic rock.

This map unit makes up about 10 percent of the survey area. It is about 34 percent San Joaquin soils and 31 percent Cometa soils. The remaining 35 percent is components of minor extent.

San Joaquin soils are moderately deep. Typically, the surface layer is medium acid sandy loam and the subsoil is mildly alkaline clay. Below the subsoil is a silica-cemented hardpan. Slope ranges from 0 to 2 percent.

Cometa soils are very deep. Typically, the surface layer is medium acid loam and the subsoil is mildly alkaline clay. Below the subsoil is mildly alkaline clay loam. Slope ranges from 0 to 2 percent.

Of minor extent in this unit are Yuvas, Snelling, Nueva, and Marcum soils; Durochrepts and Arents; and Galt, Exeter, and Capay soils.

This unit is used mainly for irrigated crops. The major crops grown are rice and nonirrigated wheat and barley. A few areas are used for irrigated pasture, nonirrigated pasture, and homesites.

The main limitations for most uses are a very low to moderate available water capacity, very slow permeability, and restricted rooting depth.

Soils in basins and on basin rims

Two map units are in this group. They make up about 43 percent of the survey area.

7. Oswald-Gridley-Subaco

Moderately deep, level to nearly level, poorly drained and moderately well drained clay and clay loam; in basins and on basin rims

This map unit is in the center of the survey area and in areas around the Sutter Buttes. The soils in this unit formed in medium textured to fine textured alluvium.

This unit makes up about 17 percent of the survey area. It is about 35 percent Oswald soils, 20 percent Gridley soils, and 17 percent Subaco soils. The remaining 28 percent is components of minor extent.

Oswald soils are poorly drained. Typically, the surface layer is neutral clay. The underlying material is moderately alkaline clay. Below this is siltstone. Slope ranges from 0 to 2 percent.

Gridley soils are moderately well drained. Typically, the surface layer is mildly alkaline clay loam. The subsoil is mildly alkaline clay. Below this is siltstone. Slope ranges from 0 to 1 percent.

Subaco soils are poorly drained. Typically, the surface layer and underlying material are moderately alkaline clay. Below this is siltstone. Slope ranges from 0 to 2 percent.

Of minor extent in this unit are Marcum, Capay, Clear Lake, Tisdale, Galt, Galt Variant, Liveoak, Liveoak Variant, Shanghai, Conejo, and Yuvas soils.

This unit is used for irrigated crops, mainly rice and prunes. Among the other crops grown are tomatoes, dry beans, sugar beets, grain sorghum, corn, and nonirrigated wheat and barley. Some areas are used for homesite development.

This unit is limited mainly by slow permeability and restricted depth to siltstone.

8. Clear Lake-Capay

Deep and very deep, level to nearly level, poorly drained and moderately well drained clay and silty clay; in basins and on basin rims

This map unit is mostly along the western edge of the survey area. It extends from the bottom of the county to the southern edge of the Sutter Buttes. There is also a small area in the southeastern part of the county. The soils in this unit formed in alluvium.

This unit makes up about 26 percent of the survey area. It is about 43 percent Clear Lake soils and 42 percent percent Capay soils. The remaining 15 percent are components of minor extent.

Clear Lake soils are poorly drained. Typically, the surface layer is slightly acid clay. The underlying material is moderately alkaline clay. Slope ranges from 0 to 2 percent.

Capay soils are moderately well drained. Typically, the surface layer is neutral to moderately alkaline silty clay. The underlying material is moderately alkaline silty clay or clay loam. Slope ranges from 0 to 2 percent.

Of minor extent in this unit are Marcum, Galt, Jacktone, Shanghai, Nueva, San Joaquin, and Yuvas soils.

This unit is used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, dry beans, sugar beets, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley and for irrigated hay and pasture.

This unit is limited mainly by slow permeability.

Soils on flood plains

One map unit is in this group. It makes up about 17 percent of the survey area.

9. Shanghai-Nueva-Columbia

Very deep, level to nearly level, somewhat poorly drained silt loam, loam, and fine sandy loam; on flood plains

This map unit is along rivers. It is scattered throughout the county. The soils in this unit formed in alluvium.

This unit makes up about 17 percent of the survey area. It is about 30 percent Shanghai soils, 26 percent Nueva soils, and 22 percent Columbia soils. The remaining 22 percent is components of minor extent.

Typically, Shanghai soils have a surface layer of neutral silt loam. The underlying material is neutral silt loam. Slope ranges from 0 to 2 percent.

Typically, Nueva soils have a surface layer of neutral loam. The underlying material is mildly alkaline to moderately alkaline loam or clay loam. Slope ranges from 0 to 2 percent.

Of minor extent in this unit are Holillipah, Byington, Shanghai Variant, Clear Lake, Capay, and Tisdale soils.

This unit is used for irrigated orchard crops, mainly walnuts, peaches, pears, and prunes. Among the other crops grown are rice, tomatoes, kiwis, corn, dry beans, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is limited by a hazard of flooding inside levees and a high water table.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the 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 on each map unit is given under "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. 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" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavior divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas 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 included areas 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 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 if intensive use of small areas is planned, onsite investigation to precisely define and locate the soils and miscellaneous areas is needed.

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 or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying layers. They also can differ in slope, stoniness, salinity, wetness, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Conejo loam, siltstone substratum, 0 to 2 percent slopes, is one phase in the Conejo series.

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 the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Marcum-Gridley clay loams, 0 to 1 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. Palls-Bohna Variant association, 30 to 60 percent slopes, is an example.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 3 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Map Unit Descriptions

101—Altamont-Dibble complex, 9 to 30 percent slopes. This map unit is on hills. In the steeper areas it has numerous springs and landslips 0.5 to 1 acre in size. The native vegetation is mainly annual grasses and forbs. Elevation is 100 and 1,200 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Altamont silty clay and 40 percent Dibble silty clay loam. The Altamont soil is on concave side slopes and toe slopes, and the Dibble soil is on convex ridgetops and upper side slopes. The components of this unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of soils that are similar to the Altamont soil but have bedrock at a depth of more than 60 inches and soils that are similar to the Dibble soil but have bedrock at a depth of 40 to 60 inches. Also included are small areas of soils on ridgetops that are similar to the Dibble soil but have more than 35 percent coarse fragments. Included areas make up about 20 percent of the total acreage.

The Altamont soil is deep and well drained. It formed in residuum derived dominantly from shale. Typically, the surface layer is brown silty clay about 27 inches thick. The upper 17 inches of the underlying material is yellowish brown silty clay, and the lower part to a depth of 52 inches is yellowish brown silty clay loam. Soft shale is at a depth of 52 inches. Depth to bedrock ranges from 40 to 60 inches.

Permeability of the Altamont soil is slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Runoff is medium to rapid, and the hazard of water erosion is high. The shrink-swell potential is high.

The Dibble soil is moderately deep and well drained. It formed in residuum derived dominantly from interbedded sandstone and shale. Typically, the surface layer is light yellowish brown silty clay loam about 5 inches thick. The subsoil is brownish yellow clay about 11 inches thick. The underlying material to a depth of 22 inches is yellow clay. Soft sandstone and shale are at a depth of 22 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Dibble soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of water erosion is high. The shrink-swell potential is high.

This unit is used as rangeland.

This unit has few limitations for use as rangeland. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. This unit responds well to fertilizer, to rangeland seeding, and to proper grazing use. The present vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass IVe (18), nonirrigated.

102—Altamont-Dibble complex, 30 to 50 percent slopes. This map unit is on hills. It has numerous springs and landslips 0.5 to 1.0 acre in size. The native vegetation is mainly annual grasses and forbs. Elevation is 100 to 1,200 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 50 percent Altmont silty clay and 30 percent Dibble silty clay loam. The Altamont soil is on side slopes, and the Dibble soil is on ridgetops. The components of this unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of soils that are similar to this Altamont soil but have bedrock at a depth of more than 60 inches and soils that are similar to the Dibble soil but have bedrock at a depth of less than 20 inches. Included areas make up about 20 percent of the total acreage.

The Altamont soil is deep and well drained. It formed in residuum derived dominantly from shale. Typically, the surface layer is brown silty clay about 27 inches thick. The upper 17 inches of the underlying material is yellowish brown silty clay, and the lower part to a depth of 52 inches is yellowish brown silty clay loam. Soft shale is at a depth of 52 inches. Depth to bedrock ranges from 40 to 60 inches.

Permeability of the Altamont soil is slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Runoff is rapid, and the hazard of water erosion is high. The shrink-swell potential is high.

The Dibble soil is moderately deep and well drained. It formed in residuum derived dominantly from interbedded sandstone and shale. Typically, the surface layer is light yellowish brown silty clay loam about 5 inches thick. The subsoil is brownish yellow clay about 11 inches thick. The underlying material to a depth of 22 inches is yellow clay. Soft sandstone and shale are at a depth of 22 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Dibble soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. The shrink-swell potential is high.

This unit is used as rangeland.

If this unit is used as rangeland, it is limited mainly by slope. Steepness of slope limits access by livestock and results in overgrazing of the less sloping areas. Proper placement of livestock watering facilities and salt improves distribution of livestock. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The present vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIe (18), nonirrigated.

103—Byington silt loam, 0 to 2 percent slopes. This very deep, poorly drained, saline-sodic soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light olive gray silt loam about 13 inches thick. The underlying material to a depth of 60 inches or more is pale brown, olive gray, light brownish gray, and light yellowish brown, stratified silt loam and silty clay loam.

Included in this unit are small areas of Columbia, Nueva, and Shanghai soils. Also included are small areas of a soil that is similar to this Byington soil but has a higher salt and sodium content. Included areas make up about 15 percent of the total acreage.

Permeability of this Byington soil is moderate. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 24 to 36 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees and is subject to rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are tomatoes, corn, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is limited mainly by the salt and sodium content and the high water table. Salinity and sodicity may reduce production of sensitive crops. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Tile or open drains can be used to remove excess water. Content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

The map unit is in capability units IIw-6 (17), irrigated, and IIIw-6 (17), nonirrigated.

104—Capay silty clay, 0 to 2 percent slopes. This very deep, moderately well drained soil is in basins and on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark grayish brown silty clay about 36 inches thick. The underlying material to a depth of 60 inches or more is brown and light yellowish brown clay loam. In some areas the soil is clay throughout.

Included in this unit are small areas of Clear Lake, Gridley, and Oswald soils. Included areas make up about 30 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, sugar beets, dry beans, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley and for irrigated hay and pasture.

This unit is suited to irrigated crops. It is limited mainly by slow permeability. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

This unit is suited to irrigated hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Excess water on the surface can be removed by grading to a suitable outlet and providing drainage ditches.

Nonirrigated areas of this unit are suited to small grain. The main limitation is slow permeability. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIs-5 (17), irrigated, and IIIs-5 (17), nonirrigated.

105—Capay silty clay, occasionally flooded, 0 to 2 percent slopes. This very deep, moderately well drained soil is in basins and on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is dark grayish brown silty clay about 36 inches thick. The underlying material to a depth of 60 inches or more is brown and light yellowish brown clay loam. In some areas the surface layer is clay.

Included in this unit are small areas of Clear Lake, Gridley, Liveoak, and Oswald soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to occasional, brief periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to rice, field crops, and small grain. It is limited mainly by slow permeability and wetness because of flooding. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface.

If this unit is used for nonirrigated crops, the main limitation is flooding. Small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

106—Capay silty clay, frequently flooded, 0 to 2 percent slopes. This very deep, moderately well drained soil is in basins. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark grayish brown silty clay about 36 inches thick. The underlying material to a depth of 60 inches or more is brown clay loam. In some areas the soil is clay throughout.

Included in this unit are small areas of Clear Lake, Gridley, Liveoak, and Oswald soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, dry beans, grain sorghum, and safflower.

This unit is suited to field crops and rice. It is limited mainly by slow permeability and wetness because of flooding. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used is generally governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water.

This map unit is in capability unit IVw-5 (17), irrigated and nonirrigated.

107—Capay silty clay, siltstone substratum, 0 to 2 percent slopes. This deep, moderately well drained soil is in basins and on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark grayish brown silty clay about 32 inches thick. The underlying material to a depth of 50 inches is brown clay loam over siltstone.

Depth to siltstone ranges from 40 to 60 inches. In some areas the soil is clay throughout.

Included in this unit are small areas of Clear Lake, Gridley, and Oswald soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. A perched water table is at a depth of 36 to 60 inches year round. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are tomatoes, corn, grain sorghum, and dry beans. Some areas are used for irrigated hay and pasture and for nonirrigated small grain.

This unit is suited to irrigated crops. It is limited mainly by slow permeability. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

This unit is suited to irrigated hay and pasture. Grasses and legumes grow well if adequate fertilizer is used. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Excess water on the surface can be removed by grading to a suitable outlet and providing drainage ditches.

Nonirrigated areas of this unit are suited to small grain. The unit is limited mainly by slow permeability. Because of this slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

108—Capay silty clay, wet, 0 to 2 percent slopes. This very deep, moderately well drained soil is in basins. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown silty clay about 16 inches thick. The underlying material to a depth of 60 inches or more is pale brown clay loam. In some areas the surface layer is clay.

Included in this unit are small areas of Clear Lake, Gridley, Liveoak, and Oswald soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A water table is at a depth of 48 to 60 inches year round. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject only to rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are dry beans, corn, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by slow permeability and poor drainage. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

Nonirrigated areas of this unit are suited to small grain. The main limitation is the slow permeability of the soil. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

109—Capay clay, hardpan substratum, 0 to 2 percent slopes. This deep, moderately well drained soil is in basins and on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown and dark grayish brown clay about 26 inches thick. The next layer to a depth of 42 inches is pale brown clay loam. The next layer is a strongly cemented hardpan 4 inches thick. Below this to a depth of 60 inches or more is light yellowish brown loam. Depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Galt and Jacktone soils and Clear Lake soils that have a hardpan. Also included are small areas of a soil that is similar to this Capay soil but is only weakly cemented at a depth of 40 to 60 inches. Included areas make up about 20 percent of the total acreage.

Permeability of this Capay soil is slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject only to rare periods of flooding.

Most areas of this unit are used for irrigated rice. A few areas are used for irrigated tomatoes, sugar beets, and field corn and for nonirrigated small grain.

This unit is suited to irrigated crops. It is limited mainly by slow permeability. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. If sprinkler irrigation is used, water needs to be applied slowly to minimize runoff. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

Nonirrigated areas of this unit are suited to small grain. The main limitation is slow permeability. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

The map unit is in capability units IIs-5 (17), irrigated, and IIIs-5 (17) nonirrigated.

110—Clear Lake silt loam, 0 to 2 percent slopes. This very deep soil is on flood plains and basin rims and in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is yellowish brown silt loam about 15 inches thick. Below this is a buried surface layer of dark gray clay 35 inches thick. The underlying material to a depth of 60 inches or more is grayish brown and light yellowish brown clay. In some areas the surface layer is loam or fine sandy loam.

Included in this unit are small areas of Capay, Oswald, and Subaco soils and Clear Lake Clay. Included areas make up about 15 percent of the total acreage.

Permeability of this Clear Lake soil is moderate to a depth of 15 inches and slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn, tomatoes, grain sorghum, dry beans, and safflower.

This unit is suited to irrigated crops. It is limited mainly by slow permeability and poor drainage. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

111—Clear Lake silt loam, frequently flooded, 0 to 2 percent slopes. This very deep soil is on flood plains and in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is yellowish brown silt loam about 15 inches thick. Below this is a buried surface layer of dark gray clay 35 inches thick. The underlying material to a depth of 60 inches or more is gray and light yellowish brown clay. In some areas the surface layer is loam, sandy loam, or fine sandy loam.

Included in this unit are small areas of Capay, Oswald, and Subaco soils and Clear Lake clay. Included areas make up about 15 percent of the total acreage.

Permeability of this Clear Lake soil is moderate to a depth of 15 inches and slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crop grown are tomatoes, corn, grain sorghum, dry beans, and safflower.

This unit is suited to irrigated crops. It is limited mainly by slow permeability, poor drainage, and wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

112—Clear Lake clay, 0 to 2 percent slopes. This very deep soil is in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark gray clay about 42 inches thick. The underlying material to a depth of 60 inches or more is olive gray clay.

Included in this unit are small areas of Capay, Oswald, and Subaco soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Clear Lake soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, sugar beets, grain sorghum, safflower, and dry beans. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by slow permeability. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil us used for rice production.

Nonirrigated areas of this unit are suited to small grain. The main limitation is slow permeability. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

113—Clear Lake clay, frequently flooded, 0 to 2 percent slopes. This very deep soil is in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. The native vegetation is mainly tules and water grasses. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is dark gray clay about 42 inches thick. The underlying material to a depth of 60 inches or more is olive gray clay.

Included in this unit are small areas of Capay, Oswald, and Subaco soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Clear Lake soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are tomatoes, corn, dry beans, grain sorghum, and safflower. Some areas are also used for wildlife habitat.

This unit is suited to field crops, including rice. It is limited mainly by slow permeability, poor drainage, and wetness as a result of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water.

If this unit is used for wildlife habitat, it is managed mainly for waterfowl. It has few limitations. Where waterfowl are nesting, it is important to provide and maintain a stable water level in spring. If fields are shaped for ponds, at least one natural mound 30 feet in diameter should be left per 2 acres of pond area. Mounds that are at least 2 feet above the normal water level provide dry nesting areas for waterfowl. Water depth and inundation period should be managed to encourage the growth of desirable natural vegetation. Excessive growth of undesirable vegetation such as cattail and tules can be effectively controlled by periodic burning and disking.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

114—Clear Lake clay, hardpan substratum, 0 to 2 percent slopes. This deep soil is in basins and on basin rims. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 10 to 40 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is dark gray clay about 14 inches thick. The upper 21 inches of the underlying material is gray clay, and the lower part to a depth of 48 inches is pale brown silty clay loam. The next layer to a depth of 60 inches or more is a strongly cemented hardpan. Depth to the hardpan ranges from 40 to 60 inches.

Included in this unit are small areas of Capay, Galt, and Jacktone soils and Clear Lake clay. Included areas make up about 20 percent of the total acreage.

Permeability of this Clear Lake soil is slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Runoff is very slow, and the hazard of water erosion is slight. A perched water table is at a depth of 36 to 60 inches in December through April. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated rice. A few areas are used for irrigated tomatoes, corn, sugar beets, and grain sorghum and for nonirrigated small grain.

If this unit is used for irrigated crops, the main limitation is slow permeability. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

Nonirrigated areas of this unit are suited to small grain. The main limitation is slow permeability. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

The map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17) nonirrigated.

115—Clear Lake clay, siltstone substratum, 0 to 2 percent slopes. This deep soil is in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is very dark gray clay about 42 inches thick. The underlying material to a depth of 48 inches is light yellowish brown clay over siltstone. Depth to siltstone ranges from 40 to 60 inches.

Included in this unit are small areas of Capay, Oswald, and Subaco soils. Also included are small areas of soils that are similar to this Clear Lake soil but have siltstone at a depth of more than 60 inches. Included areas make up about 10 percent of the total acreage.

Permeability of this Clear Lake soil is slow. Available water capacity is moderate to high. Effective rooting depth is limited by a perched water table that is at a depth of 36 to 60 inches year round. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, grain sorghum, sugar beets, safflower, and dry beans. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by slow permeability and poor drainage. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a water table. Drainage may also be needed. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production.

Nonirrigated areas of this unit are suited to small grain. The main limitation is slow permeability. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability units IIw-5 (17), irrigated, and IIIw-5 (17), nonirrigated.

116—Clear Lake clay, siltstone substratum, frequently flooded, 0 to 2 percent slopes. This deep soil is in basins. Under natural conditions the soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. The native vegetation is mainly tules and water grasses. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark gray clay about 42 inches thick. The underlying material to a depth of 48 inches is light yellowish brown clay over siltstone. Depth to siltstone ranges from 40 to 60 inches. In some areas the surface layer is stratified, brownish yellow silty clay and dark gray silty clay.

Included in this unit are small areas of Capay silty clay and Subaco clay. Also included are small areas of soils that are similar to this Clear Lake soil but have bedrock at a depth of more than 60 inches. Included areas make up about 15 percent of the total acreage.

Permeability of this Clear Lake soil is slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. A perched water table is at a depth of 36 to 60 inches year round. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to frequent, long periods of flooding from December through April.

This unit is used for wildlife habitat.

This unit is suited to wildlife habitat. It has few limitations. Where waterfowl are nesting, it is important to provide and maintain a stable water level during spring. If fields are shaped for ponds, at least one natural mound 30 feet in diameter should be left per 2 acres of pond area. High mounds that extend at least 2 feet above the normal water level provide dry nesting areas for waterfowl. Water depth and inundation period should be managed to encourage the growth of desirable natural vegetation. Excessive growth of undesirable vegetation such as cattail and tule can also be effectively controlled by periodic burning and disking.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

117—Columbia fine sandy loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown and brown fine sandy loam about 14 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown and light yellowish brown fine sandy loam and light yellowish brown very fine sandy loam. In some areas the surface layer is sandy loam or silt loam.

Included in this unit are small areas of Byington and Holillipah soils, Shanghai silt loam, and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts, prunes, and peaches. Among the other crops grown are corn, alfalfa, tomatoes, and dry beans. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It has few limitations. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Fertilizer applications should be regulated to prevent contamination of ground water. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for nonirrigated wheat and barley, the main limitation is the moderate available water capacity.

This map unit is in capability units IIs-4 (17), irrigated, and IIIs-4 (17), nonirrigated.

118—Columbia fine sandy loam, channeled, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Areas of this unit are cut by channels of abandoned streams and are marked by higher depositional bars made during flooding (fig. 1). The native vegetation is mainly trees with a dense brush understory. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown and brown fine sandy loam about 14 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown and light yellowish brown fine sandy loam and light yellowish brown very fine sandy loam. In some areas the surface layer is sandy loam or silt loam.

Included in this unit are small areas of Holillipah soils, Shanghai silt loam, and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding from December through April.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts. Among the other crops grown are peaches, prunes, pears, and tomatoes. Some areas are used for wildlife habitat.

This unit is suited to irrigated orchard crops. It is limited mainly by the hazard of flooding. Maintaining areas of trees and brush adjacent to rivers is important for streambank stabilization and erosion control. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Sprinkler irrigation is the most suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Water should be applied in amounts sufficient to wet the root zone but in amounts small enough to minimize the leaching of plant nutrients. Tilth and fertility can be improved by returning crop residue to the soil.

This unit is suited to wildlife habitat. It has few limitations. The many different kinds of vegetation in this unit support a variety of wildlife such as raptors, shore birds, waterfowl, upland game birds, and fur-bearing

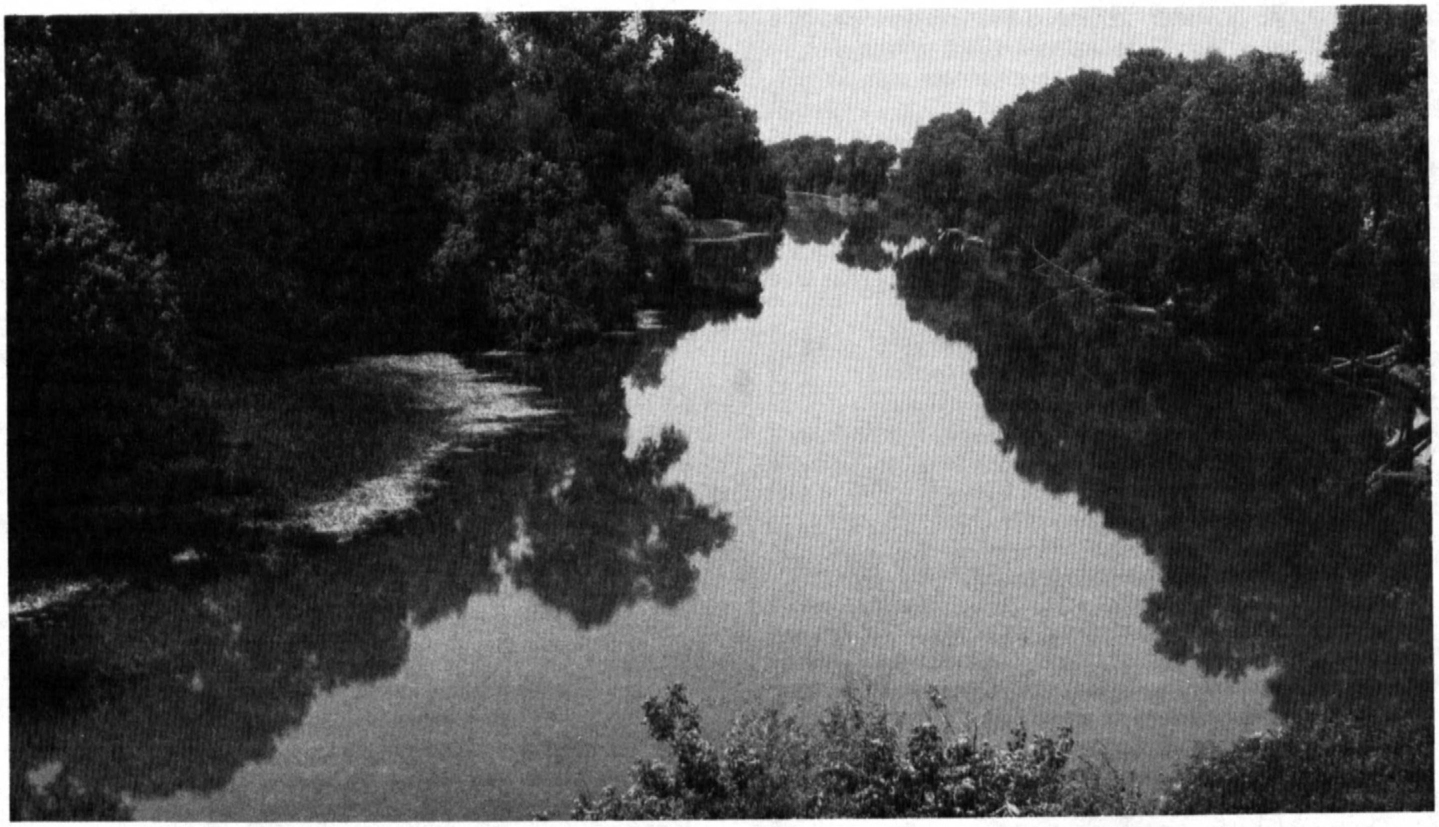

Figure 1.—A drainageway in an area of Columbia fine sandy loam, channeled, 0 to 2 percent slopes.

mammals. Management consists primarily of protecting existing vegetation, especially in areas adjacent to rivers.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

119—Columbia fine sandy loam, clay substratum, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light gray and pale brown fine sandy loam about 15 inches thick. The upper 37 inches of the underlying material is stratified, pale brown and light gray fine sandy loam, sand, very fine sandy loam, and silt loam, and the lower part to a depth of 60 inches or more is black and very dark gray clay.

Included in this unit are small areas of Holillipah loamy sand and Shanghai silt loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid to a depth of 52 inches and slow below this depth. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly peaches and prunes. Among the other crops grown are corn, tomatoes, rice, dry beans, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by the seasonal high water table and slow permeability in the subsoil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Irrigation water needs to be applied carefully to prevent the buildup of a high water table during the growing season. Drainage may also be needed. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

If this unit is used for nonirrigated wheat and barley, the main limitation is the moderate available water capacity.

This map unit is in capability units IIw-3 (17), irrigated, and IIIw-3 (17), nonirrigated.

120—Columbia fine sandy loam, clay substratum, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light gray and pale brown fine sandy laom about 15 inches thick. The upper 37 inches of the underlying material is stratified, pale brown and light gray fine sandy loam, sand, very fine sandy loam, and silt loam, and the lower part to a depth of 60 inches or more is black and very dark gray clay.

Included in this unit are small areas of Holillipah loamy sand and Shanghai silt loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid to a depth of 52 inches and slow below this depth. Available water capacity is moderate. Effective rooting depth is 40 to 60 inches. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice and tomatoes. Among the other crops grown are corn, grain sorghum, dry beans, and safflower.

This unit is suited to irrigated crops. It is limited mainly by wetness because of flooding and slow permeability in the subsoil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Irrigation water needs to be applied carefully to prevent the buildup of a high water table during the growing season. Drainage may also be needed. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

121—Columbia fine sandy loam, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. The native vegetation is mainly trees with a dense brush understory. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown and brown fine sandy loam about 14 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown and light yellowish brown fine sandy loam and light yellowish brown very fine sandy loam. In some areas the surface layer is sandy loam or silt loam.

Included in this unit are small areas of Holillipah and Tisdale soils and Shanghai silt loam. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding from December through April.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts. Among the other crops grown are peaches, prunes, pears, and tomatoes. Some areas are used for wildlife habitat.

This unit is suited to irrigated orchards. It is limited mainly by the hazard of flooding. Maintaining areas of trees and brush adjacent to rivers is important for streambank stabilization and erosion control. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Tilth and fertility can be improved by returning crop residue to the soil.

This unit is suited to wildlife habitat. It has few limitations. The many different kinds of vegetation in this unit support a variety of wildlife such as raptors, shore birds, waterfowl, upland game birds, and fur-bearing mammals. Management consists primarily of protecting existing vegetation, especially in areas adjacent to rivers.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

122—Columbia loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light gray and pale brown loam about 25 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown, very pale brown, and light gray sandy loam, silt loam, and fine sandy loam.

Included in this unit are small areas of Holillipah loamy sand, Shanghai silt loam, and Byington soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Columbia soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly walnuts. Among the other crops grown are tomatoes, corn, dry beans, grain sorghum, and safflower. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It has few limitations. Trickle, furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Tilth and fertility can be improved by returning crop residue to the soil.

Nonirrigated areas of this unit are suited to small grain. The unit has few limitations for this use.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

123—Cometa loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium derived from mixed sources. Elevation is 30 to 60 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is pale brown and brown loam about 16 inches thick. The subsoil is strong brown clay about 18 inches thick. The underlying material to a depth of 60 inches or more is yellowish red clay loam. In some areas, as a result of leveling, the surface layer is 20 to 35 inches thick.

Included in this unit are small areas of San Joaquin and Snelling soils. Included areas make up about 25 percent of the total acreage.

Permeability of this Cometa soil is very slow. Available water capacity is low. Effective rooting depth is 5 to 20 inches. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated crops, mainly rice. Some areas are used for irrigated pasture, nonirrigated pasture, and homesites.

This unit is suited to irrigated crops. It is limited mainly by the very slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitation is the very slow permeability of the soil. Because of this limitation, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

If this unit is used for nonirrigated pasture, the main limitations are the very slow permeability of the soil and a restricted period when adequate green feed is available. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Continuous, intensive, year-round grazing results in a deteriorated plant community that has low value for use as forage. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Seeding is a suitable practice if desirable species are absent in the plant community. Fertilizer is needed for optimum growth of grasses and legumes. Fencing and properly locating salt and livestock watering facilities promote uniform distribution of livestock grazing.

If this unit is used for homesite development, the main limitation is the very slow permeability of the soil. Because of this limitation, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the unit is used for septic tank absorption fields, the limitation of very slow permeability can be overcome by increasing the size of the absorption fields. Shrubs and trees adapted to shallow soils are best suited to this unit.

This map unit is in capability unit IVs-3 (17), irrigated and nonirrigated.

124—Conejo loam, 0 to 2 percent slopes. This very deep, well drained soil is on low terraces. It formed in alluvium derived from mixed sources. Elevation is 30 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is brown loam about 7 inches thick. The subsoil is brown loam about 23 inches thick. The underlying material to a depth of 60 inches or more is pale brown loam.

Included in this unit are small areas of Marcum and Tisdale soils. Included areas make up about 25 percent of the total acreage.

Permeability of this Conejo soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts, peaches, almonds, pears, and kiwi fruit. Among the other crops grown are irrigated prunes, tomatoes, corn, safflower, grain sorghum, alfalfa, sugar beets, dry beans, and melons, and nonirrigated small grain. Some areas are used for homesite development.

This unit is suited to irrigated crops. It has few limitations. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Tilth and fertility can be improved by returning crop residue to the soil.

Nonirrigated areas of this unit are suited to small grain. The unit has few limitations for this use.

This unit has few limitations for homesite development.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

125—Conejo loam, siltstone substratum, 0 to 2 percent slopes. This deep, well drained soil is on low terraces. It formed in alluvium derived from mixed sources. Elevation is 30 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is grayish brown loam about 11 inches thick. The subsoil is pale brown loam about 31 inches thick over siltstone. Depth to siltstone ranges from 40 to 60 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Included in this unit are small areas of Marcum and Tisdale soils, a soil that is similar to this Conejo soil but has a surface layer less than 20 inches thick, and a soil that is similar to this Conejo soil but has siltstone at a depth of more than 60 inches. Included areas make up about 25 percent of the total acreage.

Permeability of this Conejo soil is moderately slow. Available water capacity is moderate or high. Effective rooting depth is 40 to 60 inches. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly peaches, pears, walnuts, and prunes. Among the other crops grown are irrigated corn, tomatoes, and melons and nonirrigated small grain. Some areas are used for homesite development.

This unit is suited to irrigated crops and to nonirrigated wheat and barley. It is limited mainly by the depth to siltstone. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for homesite development, the main limitation is the depth to siltstone. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

126—Conejo-Tisdale complex, 0 to 2 percent slopes. This map unit is on low terraces. Elevation is 30 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

This unit is 45 percent Conejo loam and 40 percent Tisdale clay loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Conejo, Gridley, Liveoak, and Oswald soils and a soil that is similar to the Conejo soil but has siltstone at a depth of more than 60 inches. Included areas make up about 15 percent of the total acreage.

The Conejo soil is deep and well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown loam about 11 inches thick. The subsoil is pale brown loam about 31 inches thick over siltstone. Depth to siltstone ranges from 40 to 60 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Permeability of the Conejo soil is moderately slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

The Tisdale soil is moderately deep and well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown clay loam about 11 inches thick. The subsoil is pale brown and light yellowish brown clay loam about 20 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches. Thickness of the siltstone ranges from 6 inches to many feet. In some areas the soil is loam throughout.

Permeability of the Tisdale soil is moderately slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly peaches and prunes. Among the other crops grown are irrigated corn, tomatoes, and melons and nonirrigated wheat and barley. Some areas are used for homesite development.

This unit is suited to irrigated crops and to nonirrigated wheat and barley. It is limited mainly by the depth to siltstone. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

If this unit is used for homesite development, the main limitation is the depth to siltstone. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability unit IIIs-8 (17), irrigated and nonirrigated.

127—Conejo-Urban land complex, 0 to 2 percent slopes. This map unit is on low terraces. Elevation is 30 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

This unit is 45 percent Conejo soil and 45 percent Urban land. The components of this unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of Gridley soils and a soil that is similar to the Conejo soil but has siltstone at a depth of more than 60 inches. Included areas make up about 10 percent of the total acreage.

The Conejo soil is deep and well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown loam about 11 inches thick. The subsoil is pale brown loam about 31 inches thick over siltstone. Depth to siltstone ranges from 40 to 60 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Permeability of the Conejo soil is moderately slow. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Runoff is very slow, and the hazard of water erosion is slight.

Urban land consists of areas used as sites for residential and commercial buildings, streets, and other impermeable surfaces.

This unit is used mainly for urban development. It is also used for irrigated orchard and row crops.

If this unit is used for homesite development, the main limitation is the depth to siltstone. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This unit is suited to irrigated orchard crops and row crops. It is limited mainly by the depth to siltstone. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

The Conejo soil is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

128—Exeter sandy loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on terraces. It formed in alluvium derived from mixed sources, but dominantly from granite. Elevation is 30 to 60 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is pink sandy loam about 9 inches thick. The upper 6 inches of the subsoil is reddish yellow sandy clay loam, and the lower 15 inches is strong brown and brown sandy clay loam. The next layer is a strongly cemented hardpan 20 inches thick. The underlying material to a depth of 60 inches or more is weakly cemented sandy loam. In some areas the surface layer is 5 to 30 inches thick as a result of leveling. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Cometa, Galt, and San Joaquin soils and a soil that is similar to this Exeter soil but has a hardpan at a depth of less than 20 inches. Included areas make up about 15 percent of the total acreage.

Permeability of this Exeter soil is moderate. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated rice. A few areas are used for irrigated pasture, nonirrigated pasture, and homesites.

This unit is suited to irrigated rice. It has few limitations. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitation is the depth to the hardpan. Only plants that have a shallow rooting depth should be planted. Irrigation water needs to be applied carefully to prevent the buildup of a perched water table. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

If this unit is used for nonirrigated pasture, the main concern is a limited period when adequate green feed is available. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Continuous, intensive, year-round grazing results in a deteriorated plant community that has low value for use as forage. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Seeding is a suitable practice if desirable species are absent in the plant community. Fertilizer is needed for optimum growth of grasses and legumes. Fencing and properly locating salt and livestock watering facilities promote uniform distribution of livestock grazing.

If this unit is used for homesite development, the main limitation is the shallow depth to the hardpan. Excavation for building sites is limited by the hardpan. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the soil in this unit is used for septic tank absorption fields, the limitation of shallow depth to the hardpan can be overcome by increasing the size of the absorption field. Shrubs and trees adapted to shallow soils are best suited to this unit.

This map unit is in capability unit IIIs-8 (17), irrigated and nonirrigated.

129—Galt clay, 0 to 2 percent slopes. This moderately deep, moderately well drained soil is on basin rims. It formed in alluvium derived from mixed sources. Elevation is 10 to 40 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown clay about 10 inches thick. The next 11 inches is brown clay. The next layer is a strongly cemented hardpan 21 inches thick. The underlying material to a depth of 60 inches or more is pale yellow loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Capay, Clear Lake, and Jacktone soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Galt soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated rice. A few areas are used for sugar beets and grain sorghum.

If this unit is used for irrigated crops, the main limitation is the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IIIs-5 (17) irrigated and nonirrigated.

130—Galt clay, frequently flooded, 0 to 2 percent slopes. This moderately deep, moderately well drained soil is on basin rims. It formed in alluvium derived from mixed sources. Elevation is 10 to 40 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown clay about 10 inches thick. The next 11 inches is brown clay over a strongly cemented hardpan about 21 inches thick. The underlying material to a depth of 60 inches or more is pale yellow loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Capay, Clear Lake, and Jacktone soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Galt soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to frequent, brief to long periods of flooding in December through April.

Most areas of this unit are used for irrigated rice. A few areas are used for sugar beets and grain sorghum.

If this unit is used for irrigated crops, the main limitation is the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil, water should be applied so that it does not stand on the surface and damage the crops.

This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IVw-5 (17), irrigated and nonirrigated.

131—Garretson Variant loam, 0 to 2 percent slopes. This very deep, well drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light brownish gray loam about 15 inches thick. The underlying material to a depth of 60 inches or more is very pale brown loam.

Included in this unit are small areas of Conejo, Liveoak, and Tisdale soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Garretson Variant soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly peaches, walnuts, and prunes. Among the other crops grown are irrigated tomatoes, corn, and dry beans. Some areas are used for nonirrigated barley.

This unit is suited to irrigated crops and nonirrigated barley. It has few limitations. Orchard crops are susceptible to lime-induced iron chlorosis. Other nutrients such as phosphorus and zinc may also be unavailable. Overcoming this deficiency requires application of fertilizer in a form that will remain available to the plant. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

132—Gridley clay loam, 0 to 1 percent slopes. This moderately deep, moderately well drained soil is on terraces and basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is brown clay loam about 19 inches thick. The subsoil is brown and yellowish brown clay about 18 inches thick. Siltstone is at a depth of 37 inches. Depth to siltstone ranges from 20 to 40 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Included in this unit are small areas of Capay, Conejo, Liveoak, Marcum, Oswald, and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Gridley soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high.

Most areas of this unit are used for irrigated crops, mainly rice, prunes, and peaches. Among the other crops grown are irrigated tomatoes, corn, and melons and nonirrigated wheat and barley. Some areas are used for homesite development.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is limited mainly by the depth to siltstone and the slow permeability of the soil. Because of the restricted rooting depth, trees are subject to windthrow when the soil is wet. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used is generally governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. This unit is suited to orchard crops that are adapted to a fine textured subsoil.

If this unit is used for homesite development, the main limitations are the slow permeability of the soil, depth to siltstone, high shrink-swell potential, and low soil strength. If the soil is used for septic tank absorption fields, the limitation of slow permeability can be overcome by increasing the size of the absorption field. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load.

This map unit is in capability unit IIIs-3 (17), irrigated and nonirrigated.

133—Holillipah loamy sand, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown loamy sand about 8 inches thick. The underlying material to a depth of 60 inches or more is stratified, light gray loamy sand, pale brown loamy fine sand, and white sand.

Included in this unit are small areas of Columbia and Shanghai silt loam. Also included in old stream channels are small areas of soils that are similar to this Holillipah soil but are gravelly or cobbly throughout. Included areas make up about 20 percent of the total acreage.

Permeability of this Holillipah soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts, peaches, and prunes. Among the other crops grown are irrigated corn, tomatoes, and dry beans. Some areas are used for irrigated alfalfa.

This unit is suited to irrigated crops. It is limited mainly by rapid permeability and low available water capacity. Because the water intake rate is rapid, sprinkler irrigation is best suited to this unit. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Fertilizer applications should be regulated to prevent contamination of ground water. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

This map unit is in capability units IIIs-4 (17), irrigated, and IVs-4 (17), nonirrigated.

134—Holillipah loamy sand, channeled, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. Areas of this unit are cut by channels and have higher depositional bars, which were made during flooding. The native vegetation is mainly trees with a dense brush understory. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown loamy sand about 8 inches thick. The underlying material to a depth of 60 inches or more is stratified, white sand, light yellowish brown loamy sand, brown fine sandy loam, and pale brown loamy fine sand.

Included in this unit are small areas of Columbia and Shanghai fine sandy loam and small areas of stratified sand and gravel bars in river channels. Included areas make up about 20 percent of the total acreage.

Permeability of this Holillipah soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding in December through April.

This unit is used for wildlife habitat.

This unit is suited to wildlife habitat. It has few limitations. The many different kinds of vegetation on this unit support a variety of wildlife such as raptors, shore birds, waterfowl, upland game birds, and fur-bearing mammals. Management consists primarily of protecting existing vegetation, especially in areas adjacent to rivers.

Channeling and deposition are common along streambanks. Maintaining areas of trees and brush adjacent to rivers is important for streambank stabilization and erosion control.

This map unit is in capability unit IVw-4 (17), nonirrigated.

135—Holillipah loamy sand, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. The native vegetation is trees with a dense brush understory. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is pale brown loamy sand about 8 inches thick. The underlying material to a depth of 60 inches or more is stratified, white sand, light yellowish brown loamy sand, brown fine sandy loam, and pale brown loamy fine sand.

Included in this unit are small areas of Columbia and Shanghai silt loams and small areas of sand and gravel bars in river channels. Included areas make up about 20 percent of the total acreage.

Permeability of this Holillipah soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is severe. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts. Among the other crops grown are prunes, corn, dry beans, safflower, and grain sorghum. Some areas are used for wildlife habitat.

This unit is suited to irrigated orchards. It is limited mainly by the rapid permeability, low available water capacity, and hazard of flooding. Because the water intake rate is rapid, sprinkler irrigation is suited to this unit. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Fertilizer applications should be regulated to prevent contamination of ground water. Maintaining areas of trees and brush adjacent to rivers is important for streambank stabilization and erosion control. Maintaining a cover crop in orchards helps to control erosion during periods of flooding and helps to conserve moisture and maintain tilth.

This unit is suited to wildlife habitat. It has few limitations. The many different kinds of vegetation on this unit support a variety of wildlife such as raptors, shore birds, waterfowl, upland game birds, and fur-bearing mammals. Management consists primarily of protecting existing vegetation, especially in areas adjacent to rivers.

This map unit is in capability unit IVw-4 (17), irrigated and nonirrigated.

136—Holillipah sandy loam, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is pale brown sandy loam about 15 inches thick. The underlying material to a depth of 60 inches or more is stratified, light yellowish brown loamy sand, very pale brown silt loam, and white sand.

Included in this unit are small areas of Columbia and Shanghai soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Holillipah soil is moderately rapid. Available water capacity is low to moderate. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts and peaches. Among the other crops grown are corn, alfalfa, tomatoes, and dry beans. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Fertilizer applications should be regulated to prevent contamination of ground water. Leaving crop residue on or near the surface helps to conserve moisture, maintain tilth, and control erosion.

If this unit is used for nonirrigated wheat and barley, the main limitation is the available water capacity.

This map unit is in capability units IIs-1 (17), irrigated, and IIIs-1 (17) nonirrigated.

137—Jacktone clay, 0 to 2 percent slopes. This moderately deep soil is in basins and on basin rims. Under natural conditions this soil is somewhat poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. The soil formed in alluvium derived from mixed sources. Elevation is 10 to 40 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is dark gray clay about 25 inches thick. The next 3 inches is dark gray clay, and the next 7 inches is dark grayish brown clay loam. The next layer is a strongly cemented hardpan 4 inches thick. The underlying material to a depth of 60 inches or more is pale brown, weakly cemented loam. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Capay, Clear Lake, and Galt soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Jacktone soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. A perched water table is at a depth of 18 to 36 inches in December through April. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated rice. A few areas are used for sugar beets, tomatoes, corn, and grain sorghum.

If this unit is used for irrigated crops, the main limitation is the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IIIw-5 (17), irrigated and nonirrigated.

138—Liveoak sandy clay loam, 0 to 1 percent slopes. This very deep, well drained soil is on low terraces. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is yellowish brown sandy clay loam about 13 inches thick. The subsoil is brown sandy clay loam about 40 inches thick. The underlying material to a depth of 60 inches or more is brown sandy loam. In some areas the surface layer is sandy loam or loam.

Included in this unit are small areas of Conejo, Gridley, and Tisdale soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Liveoak soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly peaches and walnuts. Among the other crops grown are kiwi fruit, prunes, and almonds.

This unit is suited to irrigated crops. It has few limitations. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

139—Liveoak Variant-Galt Variant complex, frequently flooded, 0 to 2 percent slopes. This map unit is on flood plains. Areas of this unit are cut by channels of abandoned streams and are marked by higher depositional bars made during flooding. The native vegetation is mainly annual grasses and tules. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

This unit is 45 percent Liveoak Variant loam and 40 percent Galt Variant clay loam. The Liveoak Variant soil is on convex depositional mounds, and the Galt Variant soil is in concave channels and on inner mounds. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Columbia loam. Also included are small areas of soils that are similar to the Galt Variant soil but have a hardpan at a depth of less than 20 inches. Included areas make up about 15 percent of the total acreage.

The Liveoak Variant soil is deep and moderately well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is light brownish gray loam about 6 inches thick. The subsoil is pale brown loam about 48 inches thick. The next layer is a brown hardpan about 9 inches thick. The underlying material at a depth of 63 inches or more is pale brown very fine sandy loam. Depth to the hardpan ranges from 40 to 60 inches. In some areas the surface layer, where present, is less than 6 inches thick as a result of leveling.

Permeability of the Liveoak Variant soil is moderate. Available water capacity is moderate to high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 48 to 60 inches in December through April. This soil is subject to frequent, long periods of flooding in December through April.

The Galt Variant soil is moderately deep and somewhat poorly drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is light brownish gray and pale brown clay loam about 13 inches thick. The subsoil is light yellowish brown and very pale brown clay loam about 8 inches thick. The next layer is a white, strongly cemented hardpan 1 inch thick. The next layer is very pale brown loam 3 inches thick. Below this is a white, strongly cemented hardpan 1 inch thick. Siltstone is at a depth of 26 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is clay, and in some areas the surface layer is 20 to 30 inches thick as a result of leveling.

Permeability of the Galt Variant soil is moderately slow. Available water capacity is low to moderate. Effective rooting depth is 24 to 48 inches. Runoff is very slow, and the hazard of water erosion is slight. A perched water table is at a depth of 24 to 48 inches in December through April. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated rice. Some areas are used for wildlife habitat.

This unit is suited to irrigated rice. It is limited mainly by wetness because of flooding. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface. Tilth and fertility can be improved by returning crop residue to the soil.

This unit is suited to wildlife habitat. It has few limitations. Where waterfowl are nesting, it is important to provide and maintain a stable water level in spring. If fields are shaped for ponds, at least one natural mound 30 feet in diameter should be left per 2 acres of pond area. Mounds that are at least 2 feet above the normal water level provide dry nesting areas for waterfowl in ponds. Water depth and inundation period should be managed to encourage the growth of desirable natural vegetation. Excessive growth of undesirable vegetation such as cattail and tules can also be effectively controlled by periodic burning and disking.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

140—Marcum clay loam, 0 to 2 percent slopes. This very deep, moderately well drained soil is on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown clay loam about 9 inches thick. The upper 26 inches of the subsoil is brown clay, and the lower part to a depth of 60 inches or more is light yellowish brown clay loam.

Included in this unit are small areas of Capay silty clay and Galt and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Marcum soil is slow. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are irrigated walnuts, peaches, prunes, tomatoes, and corn and nonirrigated wheat and barley. Some areas are used for irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for nonirrigated crops, the main limitation is the slow permeability of the soil. Because of the slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

If this unit is used for irrigated pasture, the main limitation is the slow permeability of the soil. Because of the slow permeability, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

This map unit is in capability units IIs-3 (17), irrigated, and IIIs-3 (17) nonirrigated.

141—Marcum clay loam, siltstone substratum, 0 to 1 percent slopes. This deep, moderately well drained soil is on low terraces and basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is brown clay loam about 16 inches thick. The upper 12 inches of the subsoil is dark yellowish brown clay loam, and the lower 12 inches is strong brown clay. The underlying material is light yellowish brown clay loam about 3 inches thick over siltstone. Depth to siltstone ranges from 40 to 60 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Included in this unit are small areas of Conejo, Gridley, Oswald, and Tisdale soils. Included areas make up about 25 percent of the total acreage.

Permeability of this Marcum soil is slow. Available water capacity is moderate to very high. Effective rooting depth is 40 to 60 inches. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are irrigated tomatoes, corn, peaches, prunes, grain sorghum, safflower, and dry beans and nonirrigated wheat and barley (fig. 2). Some areas are used for homesite development.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is suited to fruit and nuts that are adapted to a fine textured subsoil. The unit is limited mainly by the slow permeability of the soil and depth to siltstone. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

If this unit is used for homesite development, the main limitations are the slow permeability of the soil, depth to siltstone, high shrink-swell potential, and low soil strength. If the soil is used for septic tank absorption fields, the limitation of slow permeability can be overcome by increasing the size of the absorption field. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines

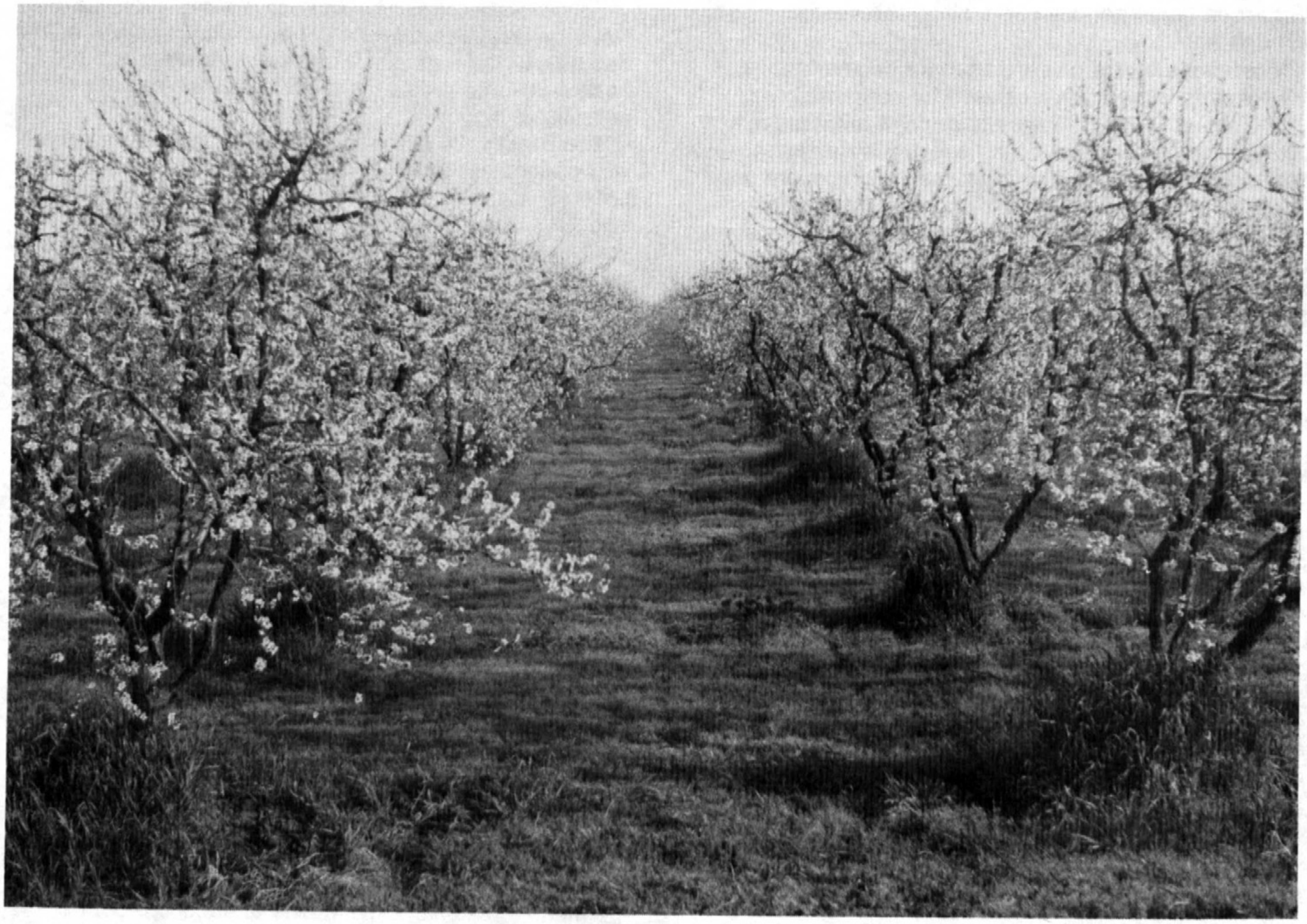

Figure 2.—Young peach orchard in an area of Marcum clay loam, siltstone substratum, 0 to 1 percent slopes.

should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil in this unit to support a load.

This map unit is in capability units IIs-3 (17), irrigated, and IIIs-3 (17), nonirrigated.

142—Marcum clay loam, occasionally flooded, 0 to 2 percent slopes. This very deep, moderately well drained soil is on basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 16 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown clay loam about 9 inches thick. The upper 26 inches of the subsoil is brown clay, and the lower part to a depth of 60 inches or more is light yellowish brown clay loam.

Included in this unit are small areas of Capay silty clay and Galt and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Marcum soil is slow. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to occasional, brief periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Some areas are used for corn and pasture.

This unit is suited to irrigated crops. It is limited mainly by the slow permeability of the soil and wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or vegetated outlets are needed to remove excess water. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitation is the slow permeability of the soil and the hazard of flooding. Wetness limits the choice of plants and the period of cutting or grazing and increases the risk of winterkill. Because of the slow permeability of the soil in this unit, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

This map unit is in capability units IIw-2 (17), irrigated, and IIIw-2 (17), nonirrigated.

143—Marcum-Gridley clay loams, 0 to 1 percent slopes. This map unit is on terraces and basin rims. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

This unit is 45 percent Marcum clay loam and 40 percent Gridley clay loam. The components of this map unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of Capay, Conejo, Liveoak, Oswald, and Tisdale soils. Included areas make up about 15 percent of the total acreage.

The Marcum soil is deep and moderately well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown clay loam about 16 inches thick. The upper 12 inches of the subsoil is dark yellowish brown clay loam, and the lower 12 inches is strong brown clay. The underlying material is light yellowish brown clay loam 3 inches thick over siltstone. Depth to siltstone ranges from 40 to 60 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Permeability of the Marcum soil is slow. Available water capacity is moderate to very high. Effective rooting depth is 40 to 60 inches. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high.

The Gridley soil is moderately deep and moderately well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown clay loam about 19 inches thick. The subsoil is brown and yellowish brown clay about 18 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches. Thickness of the siltstone ranges from 6 inches to many feet.

Permeability of the Gridley soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are irrigated peaches, prunes, corn, tomatoes, grain sorghum, and safflower and nonirrigated wheat and barley. Some areas are used for homesite development.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is suited to orchard crops that are adapted to a fine textured subsoil. This unit is limited mainly by the slow permeability of the soils. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the slow permeability of the soils, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soils are used for rice production. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

If this unit is used for homesite development, the main limitations are the slow permeability of the soils, depth to siltstone, high shrink-swell potential, and low soil strength. If the soils in this unit are used for septic tank absorption fields, the limitation of slow permeability can be overcome by increasing the size of the absorption field. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage because of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soils in this unit to support a load.

This map unit is in capability unit IIIs-3 (17), irrigated and nonirrigated.

144—Nueva loam, 0 to 1 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown loam about 17 inches thick. The upper 25 inches of the underlying material is pale brown, stratified loam and silt loam, and the lower part to a depth of 60 inches or more is dark grayish brown clay loam. A dark grayish brown clay loam is not present in some areas.

Included in this unit are small areas of Columbia and Shanghai soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Nueva soil is moderate to a depth of 42 inches and moderately slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly walnuts. Among the other crops grown are peaches, prunes, rice, tomatoes, corn, sugar beets, dry beans, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley and for homesite development.

This unit is suited to irrigated crops (fig. 3). It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

Nonirrigated areas of this unit are suited to small grain. These areas have few limitations for this use.

If this unit is used for homesite development, the main limitation is the seasonal high water table. The installation and operation of septic tank absorption fields are limited by the water table. Septic tank absorption fields do not function properly during periods of high rainfall because of wetness. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability class I, irrigated, and capability unit IIIc-1 (17), nonirrigated.

145—Nueva loam, occasionally flooded, 0 to 1 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is grayish brown loam about 22 inches thick. The underlying material to a depth of 60 inches or more is stratified, pale brown and brown loam.

Included in this unit are small areas of Snelling soils, a soil that is similar to this Nueva soil but has a surface layer less than 20 inches thick, and a soil that is similar to this Nueva soil but has a clay loam subsoil. Included areas make up about 15 percent of the total acreage.

Permeability of this Nueva soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to occasional, brief periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. A few areas are used for nonirrigated hay and irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Field ditches and pipe drops or other outlets are needed to remove excess water. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for nonirrigated hay, the main limitation is the hazard of flooding. Excess water on the surface can be removed by properly leveling and using field ditches.

If this unit is used for irrigated pasture, the main limitation is the hazard of flooding. Excess water on the surface can be removed by properly leveling and using field ditches. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff.

This map unit is in capability units IIw-2 (17), irrigated, and IIIw-2 (17), nonirrigated.

146—Nueva loam, wet, 0 to 1 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air

Figure 3.—A levee in the background protects an area of Nueva loam, 0 to 1 percent slopes. Young canning tomato crop will be mechanically harvested.

temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown loam about 17 inches thick. The upper 25 inches of the underlying material is pale brown, stratified loam to silt loam, and the lower part to a depth of 60 inches or more is dark grayish brown clay loam. A layer of dark grayish brown clay loam is not present in some areas.

Included in this unit are small areas of Columbia and Shanghai soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Nueva soil is moderate to a depth of 42 inches and moderately slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A high water table is at a depth of 48 to 60 inches year round. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are prunes, tomatoes, corn, dry beans, safflower, and grain sorghum. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops and nonirrigated small grain. It is limited mainly by the high water table. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table. Drainage may also be needed. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability units IIw-2 (17), irrigated, and IIIw-2 (17), nonirrigated.

147—Ocraig gravelly coarse sandy loam, 50 to 75 percent slopes. This very shallow, somewhat excessively drained soil is on mountains. It formed in residuum derived dominantly from extrusive igneous rock. The native vegetation is mainly annual grasses, forbs, and brush. Elevation is 500 to 2100 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

Typically, the surface layer is brown gravelly coarse sandy loam about 2 inches thick. The underlying material to a depth of 8 inches is pale brown gravelly coarse sandy loam. Hard extrusive igneous rock is at a depth of 8 inches. Depth to bedrock ranges from 4 to 10 inches.

Included in this unit are small areas of Ocraig very stony coarse sandy loam, Stohlman soils, and Rock outcrop. Also included are small areas of soils that are similar to this Ocraig soil but have bedrock at a depth of 20 to 60 inches and are in colluvial pockets. Included areas make up about 20 percent of the total acreage.

Permeability of this Ocraig soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 4 to 10 inches. Runoff is rapid to very rapid, and the hazard of water erosion is high to very high.

This unit is used as watershed and wildlife habitat.

This map unit is in capability subclass VIIs (18), nonirrigated.

148—Ocraig very stony coarse sandy loam, 30 to 50 percent slopes. This very shallow, somewhat excessively drained soil is on mountains. It formed in residuum derived dominantly from extrusive igneous rock. The native vegetation is mainly annual grasses and forbs. Elevation is 500 to 2,100 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

Typically, 15 to 50 percent of the surface is covered with stones. The surface layer is brown very stony coarse sandy loam about 2 inches thick. The underlying material to a depth of 8 inches is pale brown very stony coarse sandy loam. Hard extrusive igneous rock is at a depth of 8 inches. Depth to bedrock ranges from 4 to 10 inches.

Included in this unit are small areas of Palls and Stohlman soils. Also included are small areas of soils that are similar to this Ocraig soil but are nonstony and soils that are more than 40 inches deep and are in colluvial pockets.

Permeability of this Ocraig soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 4 to 10 inches. Runoff is rapid to very rapid, and the hazard of water erosion is high to very high.

This unit is used as rangeland.

The main limitations of this unit for use as rangeland are slope and stoniness. Steepness of slope limits access by livestock and results in overgrazing of the less sloping areas. Proper placement of livestock watering facilities and salt improves distribution of livestock. Stones on the surface limit access by livestock. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The present vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIIs (18), nonirrigated.

149—Ocraig-Rock outcrop complex, 50 to 75 percent slopes. This map unit is on mountains. The native vegetation is mainly annual grasses and forbs. Elevation is 500 to 2,117 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Ocraig very stony sandy loam and 40 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of Palls and Stohlman soils. Also included are small areas of soils that are similar to this Ocraig soil but are more than 40 inches deep and are in colluvial pockets. Included areas make up about 20 percent of the total acreage.

The Ocraig soil is very shallow and somewhat excessively drained. It formed in residuum derived dominantly from extrusive igneous rock. Typically, 15 to 50 percent of the surface is covered with stones. The surface layer is brown very stony coarse sandy loam about 2 inches thick. The underlying material to a depth of 8 inches is pale brown very stony coarse sandy loam. Hard extrusive igneous rock is at a depth of 8 inches. Depth to bedrock ranges from 4 to 10 inches.

Permeability of this Ocraig soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 4 to 10 inches. Runoff is very rapid, and the hazard of water erosion is very high.

Rock outcrop consists of exposures of bedrock. Areas generally are barren, but some areas support a few grasses and brush that grow in the cracks in the rock.

This unit is used as watershed and wildlife habitat.

This map unit is in capability subclass VIIIs (18), nonirrigated.

150—Olashes sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on alluvial fans. It formed in alluvium derived from mixed sources. Elevation is 45 to 750 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

Typically, the surface layer is pale brown sandy loam about 4 inches thick. The subsoil is pale brown and light yellowish brown sandy clay loam about 48 inches thick.

The underlying material to a depth of 60 inches or more is yellowish brown sand.

Included in this unit are small areas of Oswald soils and soils that are similar to this Olashes soil but have bedrock or a hardpan at a depth of 40 to 60 inches. Included areas make up about 25 percent of the total acreage.

Permeability of this Olashes soil is moderately slow to a depth of 52 inches and rapid below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly almonds. Among the other crops grown are walnuts, peaches, prunes, rice, and dry beans. Some areas are used for nonirrigated hay and homesite development.

This unit is suited to irrigated and nonirrigated crops. It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Abrasive volcanic sand in this soil causes rapid wear of equipment. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate.

This unit has few limitations for use as homesite development.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

151—Olashes sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on alluvial fans. It formed in alluvium derived from mixed sources. Elevation is 75 to 750 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

Typically, the surface layer is pale brown sandy loam about 4 inches thick. The subsoil is pale brown and light yellowish brown sandy clay loam about 48 inches thick. The underlying material to a depth of 60 inches or more is yellowish brown sand.

Included in this unit are small areas of Oswald soils and soils that are similar to this Olashes soil but have bedrock or a hardpan at a depth of 40 to 60 inches. Also included are small areas of Palls soils. Included areas make up about 30 percent of the total acreage.

Permeability of this Olashes soil is moderately slow to a depth of 52 inches and rapid below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for nonirrigated crops, mainly small grain and hay. Among the other crops grown are irrigated almonds.

If this unit is used for nonirrigated crops, the main limitation is droughtiness.

This unit is suited to irrigated almonds. It has few limitations. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Abrasive volcanic sand in the soil in this unit causes rapid wear of equipment. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Maintaining a cover crop in orchards reduces erosion, increases water intake, and minimizes crusting.

This map unit is in capability units IIe-1 (17), irrigated, and IIIe-1 (17), nonirrigated.

152—Olashes sandy loam, frequently flooded, 0 to 2 percent slopes. This very deep, well drained soil is on alluvial fans. It formed in alluvium derived from mixed sources. Elevation is 45 to 75 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

Typically, the surface layer is pale brown sandy loam about 4 inches thick. The subsoil is pale brown and light yellowish brown sandy clay loam about 48 inches thick. The underlying material to a depth of 60 inches or more is yellowish brown sand.

Included in this unit are small areas of Oswald soils and soils that are similar to this Olashes soil but have a hardpan at a depth of 40 to 60 inches. Included areas make up about 25 percent of the total acreage.

Permeability of this Olashes soil is moderately slow to a depth of 52 inches and rapid below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The soil is subject to frequent, long periods of flooding in December through April.

This unit is used mainly for rice production.

This unit is suited to rice production. It is limited mainly by wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry. Abrasive volcanic sand in this soil causes rapid wear of equipment.

This map unit is in capability units IVw-2 (17), irrigated and nonirrigated.

153—Oswald clay, 0 to 2 percent slopes. This moderately deep soil is in basins. Under natural conditions this soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. The soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is grayish brown clay about 15 inches thick. The underlying material is brown clay about 18 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches. In some areas the surface layer is clay loam.

Included in this unit are small areas of Conejo, Gridley, and Tisdale soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Oswald soil is slow. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. A perched water table is at a depth of 18 to 36 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are irrigated safflower, tomatoes, corn, dry beans, and grain sorghum and nonirrigated wheat and barley. Some areas are used for irrigated prunes.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It is limited mainly by the slow permeability of the soil. Because of the permeability and the wetness that results from winter rains, small grain should be planted in raised beds. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated prunes, the main limitations are the restricted rooting depth and the seasonal perched water table. Because of the restricted rooting depth, trees are subject to windthrow when the soil is wet. Field ditches and pipe drops or other outlets are needed to remove excess water.

This map unit is in capability unit IIIw-5 (17), irrigated and nonirrigated.

154—Oswald clay, frequently flooded, 0 to 2 percent slopes. This moderately deep soil is in basins. Under natural conditions this soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. This soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is grayish brown clay about 15 inches thick. The underlying material is brown clay about 18 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches. In some areas the surface layer is silty clay.

Included in this unit are small areas of Capay soils, Clear Lake clay, and Gridley, Liveoak, and Tisdale soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Oswald soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. A perched water table is at a depth of 18 to 36 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is subject to frequent, long periods of flooding from December through April.

Most areas of this unit are used for irrigated crops, mainly rice (fig. 4). Among the other crops grown are corn, dry beans, safflower, and grain sorghum.

This unit is suited to rice and field crops. It is limited by the slow permeability of the soil and wetness because of flooding. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess surface water. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IVw-5 (17), irrigated and nonirrigated.

155—Palls-Bohna Variant association, 30 to 60 percent slopes. This map unit is on mountains. The native vegetation is mainly hardwood trees with an understory of annual grasses and forbs. Elevation is 75 to 1,500 feet. The average annual precipitation is 16 to 19 inches, the average annual air temperature is 58 to 62 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Palls stony sandy loam and 35 percent Bohna Variant sandy loam. The Palls soil is on south- and west-facing slopes, and the Bohna Variant soil is on north-facing slopes and in areas adjacent to drainageways.

Included in this unit are small areas of Ocraig very stony coarse sandy loam, Rock outcrop, and soils that are similar to this Bohna Variant soil but have bedrock at a depth of 40 to 60 inches. Also included are small

Figure 4.—Rice in an area of Oswald clay, frequently flooded, 0 to 2 percent slopes, in the Sutter Bypass area.

areas of Stohlman soils. Included areas make up about 25 percent of the total acreage.

The Palls soil is moderately deep and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown and light brownish gray stony sandy loam about 8 inches thick. The subsoil is light brownish gray and pale brown gravelly sandy loam about 23 inches thick. Hard andesitic lahar is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Palls soil is moderately rapid. Available water capacity is very low to low. Effective rooting depth is 20 to 40 inches. Runoff is rapid to very rapid, and the hazard of water erosion is high.

The Bohna Variant soil is very deep and well drained. It formed in colluvium derived dominantly from extrusive igneous rock. Typically, the surface layer is brown sandy loam about 7 inches thick. The subsoil is brown and dark brown sandy clay loam about 53 inches thick.

Permeability of the Bohna Variant soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid to very rapid, and the hazard of water erosion is high.

This unit is used as woodland and livestock grazing.

This unit supports stands of blue oak and interior live oak. On the Palls soil, volumes of approximately 93 cords per acre of blue oak with an average diameter at breast height of about 12 inches have been measured. On the Bohna Variant soil, volumes of approximately 22 cords per acre of blue oak and interior live oak with an average diameter at breast height of about 4 inches have been measured. The main limitations for harvesting are the hazard of water erosion and steepness of slope. Minimizing the risk of erosion is essential when the plant cover is disturbed or removed. The steepness of slopes limits the kind of equipment that can be used. Care is needed to allow for stump sprouting to achieve regeneration of the oak.

If this unit is used for livestock grazing, the main limitation is slope. Slope and the density of the trees and brush understory limit access by livestock and promote overgrazing of the less sloping areas. Proper placement of livestock watering facilities and salt improves distribution of livestock. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The tree overstory generally is open; therefore, light reaches the ground and encourages the growth of a good understory. In areas where the canopy is dense, removal of brush in the understory encourages growth of more desirable grasses and forbs. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the characteristic plant community. The present understory vegetation on the Palls soil is mainly soft chess, wild oat, fescue, and filaree. The present understory vegetation on the Bohna soil is mainly buckbrush, poison-oak, soft chess, and wild oat.

The Palls soil is in capability subclass VIe (18), nonirrigated, and the Bohna Variant soil is in VIIe (18), nonirrigated.

156—Palls-Stohlman stony sandy loams, 9 to 30 percent slopes. This map unit is on hills. The native vegetation is mainly annual grasses and forbs. Elevation is 75 to 1,500 feet. The average annual precipitation is 16 to 18 inches, the average annual air temperature is 60 to 62 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Palls stony sandy loam and 35 percent Stohlman stony sandy loam. The Palls soil is on concave hillsides, and the Stohlman soil is on convex hillsides and on ridgetops. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ocraig gravelly coarse sandy loam and soils that are similar to the Palls soil but have bedrock at a depth of 40 to 60 inches. Also included are small areas of soils that are similar to the Palls soil but have slopes of 5 to 9 percent. Included areas make up about 25 percent of the total acreage.

The Palls soil is moderately deep and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown and light brownish gray stony sandy loam about 8 inches thick. The subsoil is light brownish gray and pale brown gravelly sandy loam about 23 inches thick. Hard andesitic lahar is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Palls soil is moderately rapid. Available water capacity is low to very low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is moderate to high.

The Stohlman soil is shallow and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is light brownish gray and pale brown stony sandy loam about 7 inches thick. The subsoil is pale brown gravelly sandy loam about 9 inches thick. Hard andesitic lahar is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Stohlman soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate to high.

This unit is used as rangeland.

If this unit is used for the production of forage, it has few limitations. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The present vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIs (18), nonirrigated.

157—Palls-Stohlman stony sandy loams, cool, 9 to 30 percent slopes. This map unit is on hills that have north, northeast, and northwest aspects. The native vegetation is mainly hardwood trees with an understory of annual grasses and forbs. Elevation is 75 to 1,500 feet. The average annual precipitation is 17 to 19 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Palls stony sandy loam and 40 percent Stohlman stony sandy loam. The Palls soil is on concave hillsides, and the Stohlman soil is on convex hillsides and on ridgetops. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ocraig very stony sandy loam and soils that are similar to the Palls soil but have bedrock at a depth of 40 to 60 inches. Also included are small areas of soils that are similar to the Palls soil but have slopes of 5 to 9 percent. Included areas make up about 20 percent of the total acreage.

The Palls soil is moderately deep and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown and light brownish gray stony sandy loam about 8 inches thick. The subsoil is light brownish gray and pale brown gravelly sandy loam about 23 inches thick. Hard andesitic lahar is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Palls soil is moderately rapid. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate to high.

The Stohlman soil is shallow and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is light brownish gray and pale brown stony sandy loam about 7 inches thick. The subsoil is pale brown gravelly sandy loam about 9 inches thick. Hard andesitic lahar is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Stohlman soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate to high.

This unit is used as woodland and livestock grazing.

This unit supports stands of blue oak. On the Palls soil, volumes of approximately 93 cords per acre of blue oak with an average diameter at breast height of about 12 inches have been measured. On the Stohlman soil, volumes of approximately 12.5 cords per acre of blue oak with an average diameter at breast height of about 9 inches have been measured. Stones on the surface limit harvesting of the blue oak. Care is needed in harvesting to allow for stump sprouting for regeneration of the oak and to minimize soil erosion when the plant cover is disturbed.

If this unit is used for forage production, it has few limitations. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The tree overstory generally is open; therefore, light reaches the ground and encourages the growth of a good understory. The present understory vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIs (18), nonirrigated.

158—San Joaquin sandy loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on terraces. It formed in alluvium derived from mixed sources, dominantly granite. Elevation is 30 to 60 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown sandy loam about 11 inches thick. The upper 5 inches of the subsoil is yellowish red sandy loam, and the lower 11 inches is yellowish red and brown clay. The next layer is a strongly cemented hardpan about 4 inches thick. The upper 8 inches of the underlying material is yellowish red sandy clay loam, and the lower part to a depth of 60 inches or more is yellowish red coarse sandy loam. Depth to the hardpan ranges from 20 to 40 inches. In some areas, as a result of leveling, the surface layer is 5 to 30 inches thick. In some areas the surface layer is loam.

Included in this unit are small areas of Cometa and Snelling soils. Also included are small areas of a soil that is similar to this San Joaquin soil but has had the surface layer removed as a result of leveling. Included areas make up about 25 percent of the total acreage.

Permeability of this San Joaquin soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is very low to low. Effective rooting depth is 10 to 35 inches. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated crops, mainly rice. Some areas are used for irrigated pasture, nonirrigated pasture, and homesites.

This unit is suited to irrigated crops. It is limited mainly by the very slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitations are the very slow permeability of the soil and depth to the hardpan. Only plants that have a shallow rooting depth should be planted. Irrigation water needs to be applied carefully to prevent the buildup of a perched water table. Because of the very slow permeability of the soil in this unit, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

If this unit is used for nonirrigated pasture, the main limitations are the very slow permeability of the soil and a limited period when adequate green feed is available.

Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Continuous, intensive, year-round grazing results in a deteriorated plant community that has low value for use as forage. Grazing when the soil is moist results in compaction of the surface layer, poor tilth, and excessive runoff. Seeding is a suitable practice if desirable species are absent in the plant community. Fertilizer is needed for optimum growth of grasses and legumes. Fencing and properly locating salt and livestock watering facilities promote uniform distribution of livestock grazing.

If this unit is used for homesite development, the main limitations are the very slow permeability of the soil and depth to the hardpan. Excavation for building sites is limited by the hardpan. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If this unit is used for septic tank absorption fields, the limitation of very slow permeability can be overcome by increasing the size of the absorption fields. Shrubs and trees adapted to shallow soils are best suited to this unit.

This map unit is in capability unit IVs-3 (17), irrigated and nonirrigated.

159—San Joaquin sandy loam, occasionally flooded, 0 to 2 percent slopes. This moderately deep, well drained soil is on terraces. It formed in alluvium derived from mixed sources, dominantly granite. Elevation is 30 to 60 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown sandy loam about 11 inches thick. The upper 5 inches of the subsoil is yellowish red sandy loam, and the lower 11 inches is yellowish red and brown clay. The next layer is a strongly cemented hardpan about 4 inches thick. The upper 8 inches of the underlying material is yellowish red sandy clay loam, and the lower part to a depth of 60 inches or more is yellowish red coarse sandy loam. Depth to the hardpan ranges from 20 to 40 inches. In some areas, as a result of leveling, the surface layer is 5 to 30 inches thick. In some areas the surface layer is loam.

Included in this unit are small areas of Cometa and Snelling soils. Included areas make up about 25 percent of the total acreage.

Permeability of this San Joaquin soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is very low to low. Effective rooting depth is 10 to 35 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to occasional, brief periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Some areas are used for irrigated pasture.

This unit is suited to irrigated crops. It is limited mainly by wetness because of flooding and the very slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated pasture, the main limitations are the very slow permeability of the soil and depth to the hardpan. Only plants that have a shallow rooting depth should be planted. Irrigation water needs to be applied carefully to prevent the buildup of a perched water table. Because of the very slow permeability of the soil in this unit, the length of runs should be adjusted to permit adequate infiltration of water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

160—San Joaquin-Arents-Durochrepts complex, 0 to 1 percent slopes. This map unit is on terraces. It has been altered by land leveling. Elevation is 20 to 50 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

This unit is 30 percent San Joaquin sandy loam, 25 percent Arents, and 25 percent Durochrepts. Some areas of San Joaquin soils that originally were on convex ridgetops were cut and are now Durochrepts. Areas of San Joaquin soils in concave swales were buried and are now Arents. The components of this unit are so intricately intermingled that it was not practical to map them separarely at the scale used.

Included in this unit are small areas of Cometa, Galt, and Snelling soils and a soil that is similar to the San Joaquin soil but has had the surface layer removed by leveling. Included areas make up about 20 percent of the total acreage.

The San Joaquin soil is moderately deep and well drained. It formed in alluvium derived from mixed sources, dominantly granite. Typically, the surface layer is brown sandy loam about 11 inches thick. The upper 5 inches of the subsoil is yellowish red sandy loam, and the lower 11 inches is yellowish red and brown clay. The next layer is a strongly cemented hardpan about 4 inches thick. The upper 8 inches of the underlying material is yellowish red sandy clay loam, and the lower part to a depth of 60 inches or more is yellowish red coarse sandy loam. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is 5 to 30 inches thick as a result of leveling.

Permeability of the San Joaquin soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is very low to low. Effective rooting depth is 10 to 35 inches. Runoff is very slow, and the hazard of water erosion is slight.

The Arents, to a depth of 48 inches, are light yellowish brown and strong brown sandy loam and sandy clay loam that are 10 to 20 percent clay fragments and 10 to 20 percent hardpan fragments. Below this is a buried surface layer of brown sandy loam 8 inches thick. The next layer to a depth of 60 inches or more is light yellowish brown clay. Depth to the buried soil ranges from 20 to 60 inches. Depth to the hardpan ranges from 40 to 60 inches or more.

Permeability of the Arents is slow to rapid. Available water capacity is low to high. Effective rooting depth is 30 to 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

The Durochrepts, to a depth of 16 inches, are light yellowish brown and very pale brown sandy loam and sandy clay loam that are 20 to 60 percent hardpan fragments and 5 to 10 percent clay fragments. A strongly cemented hardpan is at a depth of 16 inches. Depth to the hardpan ranges from 5 to 20 inches.

Permeability of the Durochrepts is moderately slow to rapid. Available water capacity is very low to low. Effective rooting depth is 5 to 20 inches. Runoff is very slow, and the hazard of water erosion is slight.

This map unit is used for irrigated rice.

This unit is suited to irrigated rice. It is limited mainly by the restricted rooting depth of the Durochrepts. Ripping and shattering the hardpan increases the effective rooting depth. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IVs-3 (17), irrigated and nonirrigated.

161—Shanghai fine sandy loam, channeled, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Areas of this unit are cut by channels and have higher depositional bars that were laid down during flooding. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light yellowish brown fine sandy loam about 15 inches thick. The underlying material to a depth of 60 inches or more is pale brown silt loam.

Included in this unit are small areas of Columbia and Holillipah soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Shanghai soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is moderate. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated orchard crops, mainly peaches and prunes. Among the other crops grown are corn, tomatoes, safflower, and grain sorghum.

This unit is suited to irrigated orchard crops. It is limited mainly by the hazard of flooding. Sprinkler irrigation is the most suitable method of applying water. Use of this method permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Maintaining a cover crop in orchards helps to control erosion during periods of flooding.

If this unit is used for irrigated row crops, it is limited mainly by wetness because of flooding. Field ditches and pipe drops or other outlets are needed to remove excess surface water. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

162—Shanghai silt loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light yellowish brown silt loam about 9 inches thick. The underlying material to a depth of 60 inches or more is stratified, light yellowish brown and very pale brown silt loam and very pale brown silty clay loam.

Included in this unit are small areas of Columbia, Holillipah, and Shanghai fine sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderate. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is slow, and the hazard of water erosion is moderate. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated orchard crops, mainly peaches. Among the other crops grown are walnuts, prunes, tomatoes, corn, and rice. Some areas are used for recreation.

This unit is suited to irrigated orchard crops. It has few limitations. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This unit is suited to recreational development. It has few limitations. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintaining adequate plant cover. Plant cover can be maintained by limiting traffic.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

163—Shanghai silt loam, clay substratum, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is yellowish brown silt loam about 12 inches thick. The upper 29 inches of the underlying material is pale brown silt loam, and the lower part to a depth of 60 inches or more is black and dark gray clay. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Conejo, Columbia, and Holillipah soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderate to a depth of 41 inches and slow below this depth. Available water capacity is high to very high. Effective rooting depth is 40 to 60 inches. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly tomatoes, corn, and rice. Among the other crops grown are peaches, walnuts, and wheat.

This unit is suited to irrigated row and orchard crops. It is limited by the seasonal high water table. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table during the growing season. Drainage may also be needed. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability units IIs-3 (17), irrigated, and IIIs-3 (17), nonirrigated.

164—Shanghai silt loam, clay substratum, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is yellowish brown silt loam about 12 inches thick. The upper 29 inches of the underlying material is pale brown silt loam, and the lower part to a depth of 60 inches or more is black and dark gray clay. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Columbia and Shanghai fine sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of the Shanghai soil is moderate to a depth of 41 inches and slow below this depth. Available water capacity is high to very high. Effective rooting depth is 40 to 60 inches. A seasonal high water table is at a depth of 48 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is moderate. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn, tomatoes, dry beans, grain sorghum, and safflower. Some areas are used for irrigated pears and prunes.

This unit is suited to irrigated crops. It is limited mainly by the seasonal high water table, hazard of flooding, and wetness because of flooding. Orchard crops, that tolerate wetness such as prunes and pears, are suited to this unit. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a high water table during the growing season. Drainage may also be needed. Field ditches and pipe drops or other outlets are needed to remove excess surface water. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

165—Shanghai silt loam, frequently flooded, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is very pale brown silt loam about 11 inches thick. The underlying material to a depth of 60 inches or more is very pale brown and pale brown silt loam. In some areas the surface layer is fine sandy loam or loamy sand.

Included in this unit are small areas of Columbia and Holillipah soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderate. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is moderate. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated orchard crops, mainly peaches, prunes, and pears. Among the other crops grown are corn, tomatoes, dry beans, grain sorghum, and safflower. Some areas are used for recreation.

This unit is suited to irrigated crops. It is limited mainly by the hazard of flooding. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Field ditches and pipe drops or other outlets are needed to remove excess surface water. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This unit is suited to recreational development. It is limited mainly by the hazards of flooding and soil blowing. Erosion and sedimentation can be controlled and the esthetic value of the area enhanced by maintaining adequate plant cover. Plant cover can be maintained by limiting traffic.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

166—Shanghai silt loam, wet, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light yellowish brown silt loam about 8 inches thick. The underlying material to a depth of 60 inches or more is stratified, light yellowish brown and very pale brown silt loam and very fine sandy loam and very pale brown silty clay loam.

Included in this unit are small areas of Columbia and Shanghai fine sandy loam. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderate. Available water capacity is high to very high. Effective rooting depth is 60 inches or more. A water table is at a depth of 30 to 60 inches in December through April and at a depth of 48 to 60 inches in May through November. Runoff is very slow, and the hazard of water erosion is moderate. This soil is subject to frequent, long periods of flooding from December through April.

This unit is used for irrigated orchard crops, mainly prunes and pears.

This unit is suited to orchard crops. It is limited mainly by the hazard of flooding and the high water table. Orchard crops that are adapted to wetness, such as prunes and pears, are suited to this unit. Maintaining a cover crop in orchards helps to control erosion during periods of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

167—Shanghai silty clay loam, 0 to 2 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light brownish gray silty clay loam about 13 inches thick. The upper 25 inches of the underlying material is light brownish gray silty clay loam, and the lower part to a depth of 60 inches or more is light brownish gray fine sandy loam. In some areas the soil is silt loam throughout.

Included in this unit are small areas of Columbia and Holillipah soils and a soil that is similar to this Shanghai soil but has underlying material of clay. Included areas make up about 10 percent of the total acreage.

Permeability of this Shanghai soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly walnuts and tomatoes. Among the other crops grown are peaches, prunes, rice, corn, grain sorghum, safflower, dry beans, and sugar beets. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops and nonirrigated wheat and barley. It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in class I (17), irrigated, and capability unit IIIc-1 (17), nonirrigated.

168—Shanghai Variant loamy sand, 0 to 1 percent slopes. This very deep, somewhat poorly drained soil is on flood plains. It formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is pale brown loamy sand about 18 inches thick. The upper 11 inches of the underlying material is light brownish gray silt loam, the next 23 inches is dark gray silty clay loam, and the lower part to a depth of 60 inches or more is dark grayish brown silty clay loam.

Included in this unit are small areas of Columbia, Nueva, and Shanghai soils. Also included are small areas of soils that are similar to this Shanghai Variant soil but have underlying material of loam. Included areas make up about 15 percent of the total acreage.

Permeability of this Shanghai Variant soil is rapid to a depth of 18 inches and moderately slow below this depth. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 36 to 60 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly walnuts. Among the other crops grown are corn and dry beans.

This unit is suited to irrigated crops. It limited mainly by the moderately rapid permeability of the surface layer. Sprinkler, trickle, and furrow irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Irrigation water needs to be applied carefully to prevent the buildup of a water table during the growing season. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

This map unit is in capability units IIs-4 (17), irrigated, and IVs-4 (17), nonirrigated.

169—Snelling loam, 0 to 2 percent slopes. This very deep, well drained soil is on stream terraces. It formed in alluvium derived dominantly from granitic sources. Elevation is 45 to 70 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown loam about 3 inches thick. The upper 16 inches of the subsoil is strong brown loam, and the lower 32 inches is reddish brown sandy clay loam and loam. The underlying material to a depth of 60 inches or more is yellowish red sandy loam.

Included in this unit are small areas of Columbia, Cometa, and San Joaquin soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Snelling soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly walnuts and peaches. Among the other crops grown are irrigated prunes and rice and nonirrigated wheat and barley. Some areas are used for irrigated pasture.

This unit is suited to irrigated crops. It has few limitations. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. This practice, however, is not applicable if the soil is used for rice production.

This unit is suited to irrigated pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Periodic mowing and clipping help to maintain uniform growth, discourage selective grazing, and reduce clumpy growth. Fertilizer is needed to ensure optimum growth of grasses and legumes.

If this unit is used for nonirrigated crops, the main limitation is droughtiness.

This map unit is in capability class I (17), irrigated, and capability unit IIIc-1, nonirrigated.

170—Snelling loam, occasionally flooded, 0 to 2 percent slopes. This very deep, well drained soil is on stream terraces. It formed in alluvium derived dominantly from granitic sources. Elevation is 45 to 70 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is brown loam about 3 inches thick. The upper 16 inches of the subsoil is strong brown loam, and the lower 32 inches is reddish brown sandy clay loam and loam. The underlying material to a depth of 60 inches or more is yellowish red sandy loam.

Included in this unit are small areas of Columbia, Cometa, and San Joaquin soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Snelling soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. This soil is subject to occasional, brief periods of flooding in November through April.

Most areas of this unit are used for irrigated crops, mainly rice.

This unit is suited to irrigated crops. It is limited mainly by wetness because of flooding. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. This practice, however, is not applicable if the soil is used for rice production.

This map unit is in capability units IIw-2 (17), irrigated, and IIIw-2 (17), nonirrigated.

171—Stohlman-Palls stony sandy loams, 30 to 50 percent slopes. This map unit is on hills. The native vegetation is mainly annual grasses and forbs. Elevation is 75 to 1,500 feet. The average annual precipitation is 16 to 18 inches, the average annual air temperature is 60 to 62 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Stohlman stony sandy loam and 35 percent Palls stony sandy loam. The Stohlman soil is on convex ridgetops, and the Palls soil is on concave side slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ocraig very stony sandy loam and Rock outcrop. Also included are small areas of soils that are similar to the Palls soil but have bedrock at a depth of 40 to 60 inches. Included areas make up about 25 percent of the total acreage.

The Stohlman soil is shallow and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is light brownish gray and pale brown stony sandy loam about 7 inches thick. The subsoil is pale brown gravelly sandy loam about 9 inches thick. Hard andesitic rock is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Stohlman soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

The Palls soil is moderately deep and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown and light grayish brown stony sandy loam about 8 inches thick. The subsoil is light brownish gray and pale brown gravelly sandy loam about 23 inches thick. Hard extrusive igneous rock is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Palls soil is moderately rapid. Available water capacity is low to very low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland.

If this unit is used as rangeland, the main limitation is slope. Steepness of slope limits access by livestock and results in overgrazing of the less sloping areas. Proper placement of livestock watering facilities and salt improves distribution of livestock. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The present vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIs (18), nonirrigated.

172—Stohlman-Palls stony sandy loams, cool, 30 to 50 percent slopes. This map unit is on hills with north, northeast, and northwest aspects. The native vegetation is mainly hardwood trees with an understory of annual grasses and forbs. Elevation is 75 to 1,500 feet. The average annual precipitation is 17 to 19 inches, the average annual air temperature is 58 to 60 degrees F, and the average frost-free period is 250 to 270 days.

This unit is 40 percent Stohlman stony sandy loam and 35 percent Palls stony sandy loam. The Stohlman soil is on convex ridgetops, and the Palls soil is on concave side slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Ocraig very stony sandy loam and Rock outcrop. Also included are small areas of soils that are similar to the Palls soil but have bedrock at a depth of 40 to 60 inches. Included areas make up about 25 percent of the total acreage.

The Stohlman soil is shallow and well drained. It formed in residuum derived dominantly from andesite and andesitic lahar. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is light brownish gray and pale brown stony sandy loam about 7 inches thick. The subsoil is pale brown gravelly sandy loam about 9 inches thick. Hard andesitic lahar is at a depth of 16 inches. Depth to bedrock ranges from 10 to 20 inches.

Permeability of the Stohlman soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate to high.

The Palls soil is moderately deep and well drained. It formed in residuum derived dominantly from extrusive igneous rock. Typically, 3 to 15 percent of the surface is covered with stones. The surface layer is brown and light grayish brown stony sandy loam about 8 inches thick. The subsoil is light brownish gray and pale brown gravelly sandy loam about 23 inches thick. Hard extrusive rock is at a depth of 31 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Palls soil is moderately rapid. Available water capacity is low to very low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is moderate to high.

This unit is used as woodland and livestock grazing.

This unit supports stands of blue oak. On the Palls soil, volumes of approximately 93 cords per acre of blue oak with an average diameter at breast height of about 12 inches have been measured. On the Stohlman soil, volumes of approximately 12.5 cords per acre of blue oak with an average diameter at breast height of about 9 inches have been measured. Stones on the surface and slope limit harvesting of the blue oak. Care is needed in harvesting to allow for stump sprouting for regeneration of the oak and to minimize soil erosion when the plant cover is disturbed.

If this unit is used for livestock grazing, the main limitation is slope. Steepness of slope limits access by livestock and results in overgrazing of the less sloping areas. Proper placement of livestock watering facilities and salt improve distribution of livestock. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Livestock grazing should be managed to protect the unit from erosion. If the range is overgrazed, the proportion of preferred forage plants decreases and the proportion of less preferred forage plants increases; therefore, livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. The tree overstory generally is open; therefore, light reaches the ground and encourages the growth of a good understory. The present understory vegetation on this unit is mainly soft chess, wild oat, fescue, and filaree.

This map unit is in capability subclass VIs (18), nonirrigated.

173—Subaco clay, 0 to 2 percent slopes. This moderately deep soil is in basins. Under natural conditions this soil is poorly drained; however, drainage has been improved by the use of open ditches and flood control structures. The soil formed in alluvium derived from mixed sources. Elevation is 20 to 50 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is dark gray clay about 13 inches thick. The underlying material is gray clay about 13 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches.

Included in this unit are small areas of Capay soils, Clear Lake clay, and Oswald soils. Included areas make up about 20 percent of the total acreage.

Permeability of this Subaco soil is slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. A perched water table is at a depth of 18 to 36 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. The shrink-swell potential is high. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are tomatoes, dry beans, sugar beets, grain sorghum, corn, and safflower. Some areas are used for nonirrigated wheat and barley.

This unit is suited to irrigated crops. It is limited mainly by the slow permeability of the soil. Furrow, border, and corrugation irrigation systems are suited to this unit. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. The method used generally is governed by the crop grown. Because of the slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

Nonirrigated areas of this unit are suited to small grain. These areas are limited mainly by the slow permeability of the soil. Because of this slow permeability and wetness that results from winter rains, small grain should be planted in raised beds.

This map unit is in capability unit IIIw-5 (17), irrigated and nonirrigated.

174—Tisdale clay loam, 0 to 2 percent slopes. This moderately deep, well drained soil is on low terraces. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is brown clay loam about 11 inches thick. The subsoil is pale brown and light yellowish brown clay loam about 20 inches thick over siltstone. Depth to siltstone ranges from 20 to 40 inches. Thickness of the siltstone ranges from 6 inches to many feet. In some areas the soil is loam throughout.

Included in this unit are small areas of Conejo, Gridley, Liveoak, and Oswald soils. Also included are small areas of a soil that is similar to this Tisdale soil but has a hardpan 0.5 to 2.0 inches thick over the siltstone. Included areas make up about 25 percent of the total acreage.

Permeability of this Tisdale soil is moderately slow. Available water capacity is low to moderate. Effective rooting depth is 20 to 40 inches. Runoff is very slow, and the hazard of water erosion is slight.

Most areas of this unit are used for irrigated orchard crops, mainly prunes and peaches. Among the other crops grown are rice, corn, tomatoes, and melons. Some areas are used for homesite development.

This unit is suited to irrigated crops. It is limited mainly by the restricted rooting depth. Because of this limitation, trees are subject to windthrow when the soil is wet. Where a thin siltstone layer is present at a root-limiting depth and is underlain by more permeable material, excavations of adequate depth should be made for each planting. Furrow, trickle, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Excessive cultivation can result in the formation of a tillage pan. This pan can be broken by subsoiling when the soil is dry.

If this unit is used for homesite development, the main limitation is the depth to siltstone. In areas where the layer of siltstone is thin and is underlain by more permeable material, septic tank absorption lines should be placed below the siltstone. Because of this restrictive layer, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability unit IIIs-8 (17), irrigated and nonirrigated.

175—Yuvas loam, 0 to 2 percent slopes. This moderately deep, moderately well drained soil is on low terraces and basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free season is 260 to 280 days.

Typically, the surface layer is light yellowish brown and pale brown loam about 16 inches thick. The subsoil is pink clay about 8 inches thick. The next layer is a strongly cemented hardpan about 14 inches thick. Siltstone is at a depth of 38 inches. Depth to the hardpan ranges from 20 to 40 inches.

Included in this unit are small areas of Conejo, Gridley, Oswald, and Tisdale soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Yuvas soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is low. Effective rooting depth is 14 to 28 inches. For insignificant periods of time after intense rainstorms in December through April, there is a perched water table at a depth of 18 to 36 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is protected by levees; therefore, it is subject to only rare periods of flooding.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn and prunes.

This unit is suited to irrigated crops. It is limited mainly by the very slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Tilth and fertility can be improved by returning crop residue to the soil.

If this unit is used for irrigated prunes, the main limitation is the restricted rooting depth. Because of this limitation, trees are subject to windthrow when the soil is wet.

This map unit is in capability unit IVs-3 (17), irrigated and nonirrigated.

176—Yuvas loam, frequently flooded, 0 to 2 percent slopes. This moderately deep, moderately well drained soil is on terraces and basin rims. It formed in alluvium derived from mixed sources. Elevation is 20 to 80 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 60 to 64 degrees F, and the average frost-free period is 260 to 280 days.

Typically, the surface layer is light yellowish brown and pale brown loam about 16 inches thick. The subsoil is pink clay about 8 inches thick. The next layer is a strongly cemented hardpan about 14 inches thick. Siltstone is at a depth of 38 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is clay loam.

Included in this unit are small areas of Oswald clay and soils that are similar to this Yuvas soil but have a clay loam surface layer. Included areas make up about 20 percent of the total acreage.

Permeability of this Yuvas soil is moderate to a depth of 16 inches and very slow below this depth. Available water capacity is low. Effective rooting depth is 14 to 28 inches. A perched water table is at a depth of 18 to 36 inches in December through April. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to frequent, long periods of flooding in December through April.

Most areas of this unit are used for irrigated crops, mainly rice. Among the other crops grown are corn, grain sorghum, safflower, and dry beans.

This unit is suited to rice production and irrigated field and row crops. It is limited mainly by wetness because of flooding and the slow permeability of the soil. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop grown. Because of the very slow permeability of the soil in this unit, water should be applied so that it does not stand on the surface and damage the crops. This practice, however, is not applicable if the soil is used for rice production. Field ditches and pipe drops or other outlets are needed to remove excess water from the surface. Tilth and fertility can be improved by returning crop residue to the soil.

This map unit is in capability unit IVw-2 (17), irrigated and nonirrigated.

Prime Farmland

In this section, prime farmland is defined and discussed and the prime farmland soils in this survey area are listed.

Prime farmland is of major importance in providing the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, seed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. Adequate moisture and a sufficiently long growing season are required. Prime farmland soils produce the highest yields with minimal units of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food and fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils commonly get an adequate and dependable supply of moisture from precipitation or irrigation. Temperature and growing season are favorable, and level of acidity or alkalinity is acceptable. The soils have few, if any, rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not flooded during the growing season. The slope ranges mainly from 0 to 6 percent.

Soils that have a high water table, are subject to flooding, or are droughty may qualify as prime farmland soils if the limitations are overcome by drainage, flood control, or irrigation. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

A recent trend in land use has been the conversion of prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on lands that are less productive than prime farmland.

About 187,402 acres, or nearly 48 percent of the survey area, would meet the requirements for prime farmland if an adequate and dependable supply of irrigation water were available.

The following map units meet the soil requirements for prime farmland when irrigated. On some soils included in the list, measures should be used to overcome a hazard or limitation, such as flooding, wetness, or droughtiness. The location of each map unit is shown on the detailed soil maps at the back of this publication. Soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use. See Appendix A for the specific criteria used to determine prime farmland.

103 Byington silt loam, 0 to 2 percent slopes
104 Capay silty clay, 0 to 2 percent slopes
105 Capay silty clay, occasionally flooded, 0 to 2 percent slopes
107 Capay silty clay, siltstone substratum, 0 to 2 percent slopes
108 Capay silty clay, wet, 0 to 2 percent slopes
109 Capay clay, hardpan substratum, 0 to 2 percent slopes
110 Clear Lake silt loam, 0 to 2 percent slopes
112 Clear Lake clay, 0 to 2 percent slopes
114 Clear Lake clay, hardpan substratum, 0 to 2 percent slopes
115 Clear Lake clay, siltstone substratum, 0 to 2 percent slopes
117 Columbia fine sandy loam, 0 to 2 percent slopes
119 Columbia fine sandy loam, clay substratum, 0 to 2 percent slopes
122 Columbia loam, 0 to 2 percent slopes
124 Conejo loam, 0 to 2 percent slopes
125 Conejo loam, siltstone substratum, 0 to 2 percent slopes

127 Conejo-Urban land complex, 0 to 2 percent slopes
131 Garretson Variant loam, 0 to 2 percent slopes
133 Holillipah loamy sand, 0 to 2 percent slopes
136 Holillipah sandy loam, 0 to 2 percent slopes
138 Liveoak sandy clay loam, 0 to 1 percent slopes
140 Marcum clay loam, 0 to 2 percent slopes
141 Marcum clay loam, siltstone substratum, 0 to 1 percent slopes
142 Marcum clay loam, occasionally flooded, 0 to 2 percent slopes
144 Nueva loam, 0 to 1 percent slopes
145 Nueva loam, occasionally flooded, 0 to 1 percent slopes
146 Nueva loam, wet, 0 to 1 percent slopes
150 Olashes sandy loam, 0 to 2 percent slopes
151 Olashes sandy loam, 2 to 5 percent slopes
162 Shanghai silt loam, 0 to 2 percent slopes
163 Shanghai silt loam, clay substratum, 0 to 2 percent slopes
167 Shanghai silty clay loam, 0 to 2 percent slopes
168 Shanghai Variant loamy sand, 0 to 1 percent slopes
169 Snelling loam, 0 to 2 percent slopes
170 Snelling loam, occasionally flooded, 0 to 2 percent slopes

Use and Management of the Soils

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

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

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

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

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

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

Crops and Pasture

General management needed for crops and for hay and pasture is suggested in this section. Cropland management is discussed; the system of land capability classification used by the Soil Conservation Service is explained; and estimated yields of the main crops and hay and pasture plants commonly grown are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Cropland Management

David H. Chaney, John F. Williams, and Charles B. Wilson, Agricultural Extension Service, and Ernst D. Paschke, Soil Conservation Service, helped to prepare this section.

Favorable soil, climate, and water conditions are responsible for the development of a very intensified and diversified agricultural industry in Sutter County. Over 318,000 acres of irrigated crops, including 20,000 acres of irrigated pasture, was harvested in 1981. More than 50 fruit, nut, field, vegetable, and seed crops are produced commercially. High land values and rising production costs make double-cropping a more efficient way to use cropland. Double-cropped land generally is planted to small grain in winter and is harvested for grain or occasionally for hay in spring. The second crop often is grain sorghum, dry beans, corn, cucurbits, or rice. Intercropping of beans, grain sorghum, or cucurbits is sometimes practiced in young orchards to make more intensive use of the available land.

Major goals of farm operators are to achieve maximum production and to maintain product quality, which maximize profit. To attain these goals, management practices are applied to protect soil fertility, prevent erosion, reduce maintenance, and conserve energy and water.

Soil management practices needed in Sutter County include conservation cropping systems, cover and green manure crops, chiseling and subsoiling, crop residue use, fertilization, conservation tillage, and pasture management. Conservation measures that can be applied on irrigated land also include practices such as land leveling and constructing irrigation pipelines, irrigation ditches, canal linings, drainage ditches, water control structures, and irrigation tailwater recovery systems. Irrigation systems commonly used are level border, graded border, furrow, subirrigation, sprinkler, trickle, and combinations of surface and sprinkler systems. An example of a combination system is the use of sprinkler irrigation on tomatoes through germination and early growth, followed by the use of furrow irrigation.

Conservation cropping systems consist of procedures for growing crops using a combination of cultural and management measures. Systems are successful when beneficial crops and practices offset the undesirable effects of soil depleting crops and practices and erosion is controlled. These conservation systems are applicable on all crops in the survey area. Management considerations include the effect of weeds, disease, and insect pests resulting from a given crop rotation. It also includes use of soil improving practices, crop rotation, and reduction of erosion to an acceptable level.

Fertilization with commercial fertilizer is essential for successful production of all commercial crops grown in the area. Nitrogen and phosphates are the primary nutrients needed for many crops. Potassium and zinc are also deficient in some soils for certain crops. Amount, type, timing, and method of applying fertilizer vary greatly according to crop, soil, crop rotation, and presence of crop residue. Determination of fertilizer requirements should be based on periodic soil tests, especially if fruit and nut crops are grown.

Cover and green manure crops are usually volunteer or planted annual grasses and legumes providing seasonal soil protection. An annually reseeding winter-growing grass should be seeded before October 15. Some growth will occur in winter, providing erosion control. In spring, the cover crop can be mowed to a height of 4 inches to reduce potential frost damage to the crop. To allow development and maturity of the seed, the cover crop should not be mowed after it starts to head. After viable seed has set, the crop can be mowed at any height. The viable seed will be available the following fall to start the annual growth cycle over again. Occasionally, cropland is seeded to annual legumes, particularly following leveling. In addition to providing cover for erosion control, organic matter is added to the soil when the cover crop is disked into the soil in spring to improve infiltration, aeration, and tilth. In many sprinkler irrigated nut orchards, vegetation is controlled by mowing and strip-spraying tree rows.

Growing annual grasses in orchards is advantageous because they provide protection from erosion in winter. These grasses set viable seed and die early in summer; therefore, they do not deplete soil moisture during the latter part of the growing season.

Chiseling and subsoiling are used to increase the effective rooting depth in soils that have a plowpan or hardpan. Chiseling the plowpan and subsoiling the hardpan increase permeability and internal drainage, help to prevent a perched water table from developing, and allow deeper penetration of roots. Chiseling also temporarily benefits soils that have a clay subsoil; however, these soils will eventually return to their original condition. The San Joaquin soils in the southeastern part of the county may benefit from subsoiling. Depth of subsoiling should be based on the depth to the bottom of the hardpan. Crops such as rice grow well on these soils without modification of the hardpan.

Crop residue use helps to maintain soil tilth, organic matter content, and fertility and increases the water intake rate. Crop residue usually is incorporated into the soil. Some crop residue, such as winter cereal straw, is often burned or baled to permit preparation of the seedbed if double-cropping is practiced. Rice stubble is also customarily burned for disease control and as a practical way to dispose of the large amounts of organic matter produced. Orchard prunings generally are shredded or incorporated into the soil.

Conservation tillage is performing the crop cultivation operations necessary to control weeds, obtain favorable movement of air and water in the soil, and prepare an adequate seedbed in a sequence and manner that maintain at least 30 percent of the soil surface covered by residue after planting. Combining tillage operations to reduce the number of trips over a field and delaying tillage operations while the soils are wet are important factors in maintaining soil tilth, preventing compaction, and conserving energy.

Pasture management is essential to achieve maximum production, maintain desirable plant populations, and extend the productive life of the pasture. Rotation grazing and occasional mowing to maintain uniform growth are desirable. Deferring grazing when the soil is wet helps to prevent compaction. Commercial ranchers usually move livestock to annual rangeland in the Sutter Buttes or in other upland areas during the rainy season, when the production of pasture is minimal and the soils are wet.

Irrigation water management can be achieved only if the land is properly leveled for the type of crops to be produced and the facilities necessary for the efficient distribution of water have been installed. Irrigation water should be applied according to crop requirements and at frequencies and rates and in amounts that will promote optimal production and minimal runoff and erosion.

Although most of the irrigated land in the survey area has been leveled, much is being releveled to improve irrigation efficiency and permit production of a greater variety of crops.

Pipelines or lined concrete ditches are replacing open earth ditches to conserve water and reduce maintenance costs. Drainage ditches and erosion control structures to safely dispose of tailwater or of surface runoff in winter commonly are needed. Irrigation tailwater return systems are occasionally installed. More often, the tailwater enters drainage ditches and becomes the irrigation water supply for downstream operators. Except when rice fields are drained prior to harvest in August or September, very little irrigation tailwater leaves the area during the irrigation season.

Subsurface water removal is required on some soils that have a high water table. These soils are in the western part of the survey area, primarily in the Meridian area. Nueva loam, wet, is an example of a soil that has a permanent high water table. Open drainage ditches or subsurface drainage pipes may be needed to keep the water table below the root zone of plants. Seepage may also be a problem along the Sacramento River, the Sutter Bypass, and the Feather River during periods of high river flow.

Irrigation canals and rice fields also frequently impact adjacent lands through seepage. Seepage problems delay or restrict cultural operations, such as disking, and may reduce crop yields. When seepage persists over long periods of time, it can cause loss of trees in established orchards. Installing subsurface interceptor or open drains and planting annual shallow rooted or water tolerant crops, such as rice or pasture, are the primary management alternatives where these conditions exist.

Toxic salt reduction is needed on soils that have excessive amounts of salt and alkali. The primary saline-sodic area in Sutter County is in the Sutter Basin, in the southwestern part of the county, near the Sacramento River. Byington soils are the primary saline and sodic soils. Reclamation of these soils generally is accomplished by planting salt tolerant crops such as small grain, providing adequate drainage, and overirrigating to permit leaching of salts. Incorporation of large amounts of crop residue also aids the reclamation process by improving aeration, increasing the water intake rate, and improving the soil structure.

Soils strongly influence the kind of crop and pasture plants that can be grown. In areas that have similar climate and topography, crops that can be grown are related closely to the kind of soil. Crops that are suited to the soils in the survey area are discussed in the paragraphs that follow. The suitability of each soil for growing a given crop is presented in the section "Detailed Soil Map Units."

Prunes are grown on soils such as those of the Marcum, Gridley, and Tisdale series. Because prunes are least affected by soils that have fine texture or limited rooting depth, recent plantings have been made on marginal soils such as Oswald clay. Harvesting is done by use of catching frames and truck shakers. Irrigation water is most frequently applied in contour checks or level basins, but some furrow, border, sprinkler, and trickle irrigation is also used. Total net irrigation water requirement is about 24 inches annually. Nitrogen and potassium fertilizer is applied in some years according to crop requirements. Foliar sprays containing zinc are also often used. Russet scab, San Jose scale, peach tree twig borers, aphids, and mites are controlled by using a single spray during the dormant season.

Peaches are grown on the Conejo, Tisdale, and Marcum soils. Most orchards are adapted for mechanical harvesting, though many are still harvested by hand. Nearly all peaches are surface irrigated. The annual net irrigation water requirement is about 26 inches. Peaches are a labor intensive crop that involves detailed pruning, hand thinning of fruit, and an extensive pest control program. Ground or aerial spraying for dormant insect and disease control and for blossom and preharvest brown rot control is essential. Nitrogen usually is applied each year. Foliar zinc sprays commonly are applied in spring. The winter cover crop is disked into the soil in spring as soon as orchards are dry enough for cultivation. Contour checks usually serve for two irrigations before they are knocked down prior to disking for weed control. Periodic uniform orchard planning is desirable to maintain the grade needed for efficient irrigation and for surface drainage in winter.

Kiwi fruit has become a popular crop because of its profitability. Kiwis are best adapted to soils that are well drained, such as those of the Liveoak and Conejo series. One male vine generally is planted for every eight female vines. Construction of a trellis system is essential. The first commercial harvesting generally is in the fourth year.

Planting site preparation usually includes land leveling, ripping, and fumigation to control pests such as oak root fungus and nematodes.

Overhead sprinkler systems are installed primarily for frost protection and for cooling in summer, but they are also used for irrigation. A second irrigation system, generally a trickle system, is also commonly installed. Vegetation between rows is controlled by mowing. Windbreaks are frequently planted.

Walnuts are grown on deep, well drained soils such as those of the Holillipah and Columbia series. Orchards are sometimes interplanted with temporary trees that are removed when the trees become crowded. Fertilizer applications are required, and they should be based on the results of soil tests. Planting site preparation includes land leveling, ripping to improve internal soil drainage, and fumigation for soil-borne pests. Net irrigation water requirement is about 23 inches per year. Surface flood irrigation commonly is used, but sprinklers are also frequently used. Use of portable and fixed sprinklers is compatible with nontillage systems and fits well into the procedures used for harvesting walnuts. A smooth, firm ground surface is maintained to permit sweeping and pickup of nuts from the ground after shaking. Tree rows are strip-sprayed, and vegetation is mowed close to the ground. Pest control in walnut orchards includes spraying for blight, codling moth, aphids, and husk fly.

Almonds generally are planted in a hexagonal pattern. In the Sutter Buttes area, almonds grow on the Olashes soils. Almonds prefer well drained soils, but they also can be grown on finer textured soils if Marianna root stock is used. Selection and spacing of appropriate pollinating varieties is essential for good production. Suitable pest control includes dormant spraying for mites, scales, and peach tree borer and blossom sprays for brown rot and shothole fungus. Fertilizer applications are required, and they should be based on the results of soil tests. Net irrigation water requirement is about l9 inches per year. Sprinkler trickle irrigation are used in almond orchards. Vegetation is controlled by mowing and strip-spraying the tree row.

Tomatoes for processing are the most important row crop grown in the survey area. They are planted from March through June to spread the harvest period in order to make efficient use of canning facilities. Tomatoes are direct-seeded in wide beds with furrows. Nitrogen, phosphorus, and zinc fertilizer is used. Pests include flea and darkling ground beetles, fruitworm, cutworm, mites, fusarium, water mold, and bacterial leaf diseases and various weeds. They are controlled by use of cultural practices such as crop rotation, varietal selection, water management, and tillage and by use of pesticides. Sprinkler or furrow irrigation can be used. Net irrigation water requirement is about l8 inches per year. Harvesting from July through mid-October is done by mechanical harvester. Crop residue is incorporated into the soil after harvest.

Management practices for other row crops such as sugar beets, dry beans, melons, pumpkins, and squash are specific to the crop grown. Proper preparation of seedbeds and management of irrigation water, proper amount, kind, and timing of fertilizer applications, and suitable pest control practices are essential for successful production. These row crops commonly are grown in rotation with other crops. Rotations are determined by pest control considerations, the marketing potential of any given crop, the farm operator's expertise, and the availability of equipment.

Rice occupies the largest acreage and produces the highest gross income of all crops in the survey area. Rice is well adapted to the area because of the hot climate and abundance of water. Also, the fine textured soils in the basin areas are suited to the impoundment of water. Rice is grown in leveled areas of fine textured soils and on soils that have a hardpan or claypan, such as those of the Clear Lake, Subaco, Capay, San Joaquin, and Cometa series.

Rice is grown in large, level basins or with a contour check system to maintain uniform water depth. Water management is a critical production component. The seasonal requirement ranges from 6 to l4 acre-feet, depending on the kind of soil and slope and on the management used.

Fields usually are flooded from April 20 to May 20, followed by direct seeding of presoaked seed. Nitrogen deficiency is universal. Phosphorus and zinc are widely used. Potassium is occasionally applied on soils such as those of the San Joaquin series. Most fertilizers are applied before the fields are flooded; however, supplemental nitrogen is often needed during midseason. Herbicides and pesticides generally are applied by aerial methods. Fields are drained from mid-August to mid-September, with harvest beginning late in September. Stubble and straw residue usually is burned. Crop rotation is used in some areas to control weeds and disease and to maintain soil fertility. Wheat is a popular rotation on very fine textured soils, but safflower, tomatoes, corn, and grain sorghum are also rotated with rice in the Sutter Basin. Rice usually is grown without rotation on some soils, such as those of the San Joaquin series, because their rooting depth is too shallow for row crops.

Wheat is grown throughout Sutter County in both irrigated and nonirrigated areas. Management practices differ considerably, depending on yield potential. Spring wheat is planted in November through January in irrigated areas and is harvested from late in May through June. High-yielding areas such as Sutter Basin receive more fertilizer and are more likely to be irrigated, particularly in dry years. Nonirrigated areas are mostly in and around the Sutter Buttes, and seeding and fertilization rates used in these areas are lower than those used in irrigated areas. When wheat is irrigated, total requirements for water can range from 3 to 15 inches, depending on rainfall, planting date, kind of soil, and method of application.

Problems associated with growing winter cereal are the saturation of the soil, which causes loss of stands, poor growth, and loss of nitrogen; insufficient soil moisture in spring; periodic foliar disease outbreaks; and frost damage. Provision for surface drainage and irrigation water applications through use of raised beds is a popular practice on fine textured soils such as those of the Clear Lake, Capay, Subaco, and Oswald series.

Split applications of nitrogen are used to increase efficiency. Diseases are managed through a combination of cultural practices, including variety selection, crop rotation, residue disposal, and time of planting. Weeds and insects (aphids) are managed by use of cultural practices and chemical sprays.

Wheat commonly is used in double-cropping systems, usually in combination with grain sorghum or dry beans and, to a lesser extent, with rice and corn. Wheat frequently is rotated with rice, tomatoes, safflower, and corn in irrigated areas. Barley is grown as a feed grain, and it is almost entirely a nonirrigated crop. Barley can be planted when it is too late to plant wheat or under conditions of limited soil moisture. Wheat is used for flour and feed and is preferred to barley because it produces higher yields and generally brings a higher price. Oats are grown almost entirely for hay and, to a limited extent, for seed production.

Grain sorghum is planted from April to July. It is planted in rows, on beds, or more commonly in a contour check system. It is less intensively farmed than corn. Grain sorghum is surface irrigated. Net irrigation water requirements is about 15 to 23 inches per year, depending on planting date and kind of soil. Nitrogen fertilizer is applied each season. Phosphorus may be banded with or near the seed when planted very early or in rotation with rice. Grain sorghum is a popular double-crop that commonly follows wheat.

Corn is planted for grain and silage. As with other row crops, the management for corn is quite sophisticated, including intensive soil preparation, precision planting, banded placement of starter fertilizer, preplanting application of herbicides, and great care in timing, application, and cutoff of irrigation. Corn is usually planted when the soil is moist in spring and on raised beds. Nitrogen commonly is applied in split applications. A small acreage can be planted as a double-crop following wheat or barley. Net irrigation water requirement ranges from 24 to 28 inches per year, depending on the planting date and the use to be made of the crop.

Alfalfa is grown throughout the survey area, but it generally is grown on the deep, better drained soils such as those of the Conejo series. Alfalfa is planted either in fall or in spring. Semidormant varieties are most suitable. Since vigorous growth of alfalfa depends upon the presence of nitrogen-fixing Rhizobium bacteria, the seed should be inoculated if these bacteria are not present in the field to be planted. The stand life generally is 4 to 5 years. Yields range from 5 to 8 tons per season with 5 to 6 cuttings. Egyptian alfalfa weevil, pea aphid, blue alfalfa aphid, alfalfa caterpillar, and other insect pests are controlled with insecticides. Herbicides are used to control weeds. The quality and life of the stand are increased and risk of Phytophthora root rot is reduced by not planting alfalfa on shallow or slowly permeable soils or on soils that are wet or inadequately drained. Irrigation water management is also extremely important if alfalfa is grown. Border irrigation is most frequently used. The net irrigation water requirement is about 38 inches per year.

Irrigated pastures are on all kinds of soil and in most parts of the survey area. Border irrigation is the main method used, but sprinklers commonly are used on small acreages. The net irrigation water requirement is about 32 inches annually. The plants best adapted to the area include ladino clover, strawberry clover, narrowleaf trefoil, broadleaf trefoil, perennial ryegrass, orchardgrass, and tall fescue. Suitable pasture management includes rotation grazing, occasional mowing to maintain uniformity of the stand and to control annual weeds, irrigation water management, and proper fertilization. Optimal production is achieved by applying sufficient nitrogen and phosphorus.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 4. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

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

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

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum. For yields of tree crops, it is also assumed that trees are at their peak productive age.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 4 are grown in the survey area. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*16*). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes. See Appendix B for the specific criteria used to determine land capability classes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6. The numbers used to designate units within the subclasses are as follows:

0. Indicates limitations caused by stony, cobbly, or gravelly material in the substratum.
1. Indicates limitations caused by slope or by an actual or potential erosion hazard.
2. Indicates a limitation of wetness caused by poor drainage or flooding.
3. Indicates a limitation of slow or very slow permeability of the subsoil or substratum is caused by a clayey subsoil or by a substratum that is semiconsolidated.
4. Indicates a low available water capacity in sandy or gravelly soils.
5. Indicates limitations caused by a fine-textured or very fine-textured surface layer.
6. Indicates limitations caused by salts or alkali.
7. Indicates limitations caused by rocks, stones, or cobblestones.
8. Indicates that the soil has a very low or low available water capacity because the root zone generally is less than 40 inches deep over massive bedrock.
9. Indicates that a problem or limitation is caused by low or very low fertility, acidity, or toxicity that cannot be corrected by adding normal amounts of fertilizer, lime, or other amendments.

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

Land Resource Areas

Capability classification is further refined by designating the land resource area in which the soils in a unit occur (*18*). A land resource area is a broad geographic area that has a distinct combination of climate, topography, vegetation, land use, and general type of farming. Parts of two of these nationally designated areas are in the survey area. These areas and their numbers are: Sacramento and San Joaquin Valley (17) and Sierra Nevada Foothills (18). The number of the resource area is given in parenthesis after the capability classification in the detailed soil map unit descriptions.

Land resource area 17.—Most of the survey area is in this area. It includes the soils on alluvial flood plains, terraces, and basins in the Sacramento Valley. The natural vegetation is mainly annual grasses and valley oak. Elevation mainly ranges from 10 to 80 feet, but a few areas in the Sutter Buttes are at an elevation of as much as 750 feet. The average annual precipitation ranges from 14 to 20 inches, the average annual temperature ranges from 60 to 64 degrees F, and the average frost-free season ranges from 260 to 280 days.

Within this survey area, most of the land in this resource area is used as irrigated cropland. A few small areas are used for urban land and wetland. The main crops are fruit, nuts, vegetables, small grain, and row crops.

Land resource area 18.—The northern part of the survey area is in this area. It comprises the upland parts of the Sutter Buttes and is dominantly on hills and mountains. Natural vegetation is mainly annual grasses, forbs, and blue oak. Elevation ranges from 75 to 2,117 feet. The average annual precipitation ranges from 16 to 19 inches, the average annual temperature ranges from 58 to 62 degrees, and the average frost-free season ranges from 250 to 270 days.

Within this survey area, most of the land in this resource area is used as rangeland and wildlife habitat.

Rangeland

By Sharon Larivee, range conservationist, Soil Conservation Service.

About 40,000 acres of the survey area is rangeland, most of which is in the Sutter Buttes. The rest is around Nicolaus and along the Sutter-Placer county line. Livestock and their products made up 7 percent of the total farm income in 1980 (*10*). Several different types of livestock operations are used in this area, but the most commonly used is the cow-calf operation. Others used include stocker, dairy, and sheep operations. The number of ranches in the survey area is slowly decreasing.

The vegetation on Sutter Buttes is predominantly annual grasses and oaks. Perennial grasses are scattered throughout this area. The presence of perennial grass reflects a history of proper use. Many ranchers own or lease irrigated pasture in summer. In winter the livestock are returned to higher ground in the Sutter Buttes or other upland areas outside the survey area.

The adequate green feed period starts late in winter, about February, and lasts until the middle of May. Supplemental feeding of hay commonly is practiced late in summer and in fall. In some cases liquid protein is also used.

To fully use the resources available on rangeland, an understanding of the climate and soils is important. The climate of the survey area is characterized by hot, dry summers and cool, wet winters. Temperatures are coldest when the highest amounts of moisture are received and are warmest when very little if any rain is received; therefore, plant growth is optimum for only a couple of months. Annual grasses are well adapted to this kind of rainfall pattern. They grow quickly in spring, set seed, and then die by June, when the weather turns hot (*8*).

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are closely related to the kinds of soil.

Soils strongly influence the natural vegetation. In the Sutter Buttes area, there are three different kinds of soil. The center of the area is made up of steep, shallow to deep, coarse sandy loam over igneous rock. Rock outcroppings are common. The production of forage is minimal on these soils. The vegetation varies from annual and perennial grasses to brush, deciduous trees, and live oaks.

Along the perimeter of the Sutter Buttes area is shallow to moderately deep sandy loam over igneous rock. These soils are on the ramparts surrounding the rocky core. Production is poor to moderately good, depending on the depth of the soil. The vegetation on these soils varies with the aspect. The south and west aspects dominantly support annual grasses and a few oaks. The north and east aspects support significant stands of blue oak with an understory of annual and perennial grasses. The removal of oaks often results in a permanent change in vegetation. The oaks are unable to become reestablished in areas they previously dominated.

The third kind of soil on the Sutter Buttes is in scattered areas between the rocky core and the outer ramparts. These soils are deep and clayey. They formed in residuum derived from sedimentary rock that was uplifted when the buttes formed. These soils produce large amounts of annual grasses.

The major management concerns for the rangeland in the survey area are briefly described in the following paragraphs. They include proper grazing use, proper season of use, distribution of livestock grazing, water development, stock trails, cross fencing, seeding, and fertilizing.

Proper grazing use is grazing at an intensity that will maintain enough cover to protect the soil and maintain or improve the quality and quantity of desirable vegetation. On annual grassland, it is necessary to allow a part of the desirable species to set seed if they are to be maintained in the plant community. Because wildlife and livestock graze selectively, only the unpalatable species will be allowed to reproduce unless grazing is controlled. The dry vegetation left on the rangeland at the beginning of the fall-winter period helps to promote the growth of green forage and protects the new seedlings from drying winds. The decomposing herbaceous material on the soil surface and partially mixed with mineral soil conserves moisture and promotes establishment and early growth of the seedlings. Determination of the amount of residue left should be done just prior to the beginning of the rainy season.

Proper season of use means grazing only during seasons when the range is best suited to grazing. In this survey area three seasons are recognized: The dry forage season, the inadequate green feed season, and the adequate green feed season. The *dry forage season* is from about June through October. Some of the current year's growth should be left to conserve soil moisture to protect the soil from erosion and to enhance soil fertility. The *inadequate green feed season* is usually between November and January. Most of the plant growth occurs during short rainy periods. Supplemental feeding is necessary during the periods of uncertain plant growth. The *adequate green feed season* lasts from about February through May. During this period there is enough forage to feed the livestock during the grazing season and to leave enough of the current year's growth of desirable forage plants for growth the following year. Grazing in spring should be delayed until the amount of desirable forage species is sufficient and the soil conditions are such that mechanical damage will not occur.

Distribution of livestock grazing involves use of practices that encourage livestock to spread out and use the forage within a grazing unit as uniformly as possible. The objective is to minimize overuse and waste of forage and to maximize proper use consistent with a practical goal set for a grazing unit. Grazing units vary in the amount of water and shade distribution, topography, kinds of forage available, class of the livestock grazing them, and the season of use. Salt should be located in areas where more grazing is desired and not next to watering facilities.

Livestock water development, where feasible, is valuable in distributing grazing pressure. If livestock are required to travel long distances to and from water, weight gain and distribution are greatly minimized. This also encourages overuse of forage in the vicinity of existing water. The number of watering facilities needed depends on the kinds of livestock grazed and on the weather and topography.

Stock trails can provide access to forage or water that is otherwise inaccessible. Many areas in the Sutter Buttes have not been grazed because of poor access or rocky terrain. Use of stock trails improves grazing efficiency.

Cross-fencing is another way to concentrate animals in areas they would ordinarily avoid. It helps to achieve more uniform use of available forage.

Range seeding can improve forage production and plant composition. The best results are obtained in areas that have a high potential for production but for various reasons are not producing at their maximum potential. Natural disasters, such as fire or drought, may make seeding necessary. Seeding can be used effectively to convert cropland to rangeland.

Fertilization generally is not used because of the high cost. Some ranchers fertilize periodically if the current year's rainfall is sufficient for good results.

Technical assistance in rangeland management can be obtained from local office of the Soil Conservation Service or the Cooperative Extension Service.

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

Table 5 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 5 follows.

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

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

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

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

Recreation

The soils of the survey area are rated in table 6 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 6, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures. The specific criteria used to determine soil limitations are given in Appendix C.

The information in table 6 can be supplemented by other information in this survey, for example, interpretations for dwellings without basements and for local roads and streets in table 8 and interpretations for septic tank absorption fields in table 9.

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

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

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

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

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

By Larry H. Norris, biologist, Soil Conservation Service.

Fish and wildlife are valuable resources in the survey area. They improve the quality of the environment and act as early indicators of pollution. Many types of wildlife help in the natural control of weeds, insects, and animal pests. They also provide numerous opportunities for recreation, including nature study, bird watching, hunting, and fishing.

The Sacramento and Feather Rivers provide habitat for salmon, striped bass, steelhead, shad, and sturgeon. Warmwater fish, including largemouth bass, smallmouth bass, bluegill, and catfish, inhabit the rivers and ponds in the area. Corridors of riparian vegetation along the rivers, creeks, and drainage areas provide habitat for mammals, birds, reptiles, amphibians, and insects. In the areas developed for intensive agriculture, these riparian corridors commonly account for the only perennial wildlife habitat. Although these riparian areas are of great value to wildlife, for the purpose of this survey some have not been mapped as separate units because of their small size.

Generally, as farming has intensified in the survey area, wildlife habitat has decreased. This is the result of the use of clean tillage and elimination of irrigation and drainage ditches and odd field corners, which provide much of the habitat for the population of ring-necked pheasant and other wildlife.

The "Butte Sink" area of Sutter County provides important habitat for resident waterfowl and for wintering of migratory waterfowl. The wetlands and marshes of the Butte Sink play a critical role in maintaining California's waterfowl populations. These areas, which include part of the Graylodge Wildlife Management Area and privately owned duck clubs, account for about 18,000 acres of natural wetland vegetation.

Man's activities have various effects on the wildlife population. Many species, such as coyotes, blackbirds, and ground squirrels, can tolerate man's activities and actually thrive in close association with him. In contrast, the existence of some species has been threatened by man and his activities.

Some wildlife species listed as rare or endangered occur in Sutter County. The rare California yellow-billed cuckoo lives primarily in the dense vegetation along some stretches of the Sacramento and Feather Rivers. In winter the endangered Aleutian Canada goose inhabits private duck club reserves and farmland in the southern part of the Butte Sink.

In the following paragraphs, the wildlife habitat in the survey area is discussed according to the general soil map unit group in which it occurs.

Soils on flood plains.—These soils have good to fair potential for development of openland wildlife habitat. The main limitation is the hazard of flooding. Frequent flooding can affect the growth and production of grain and seed crops, which provide food and some cover for openland wildlife. Maintaining and improving existing stands of trees and brush in odd areas, along irrigation and drainage ditches, and especially in areas adjacent to rivers provide year-round hiding, resting, and nesting areas.

There is good potential to develop wetland habitat on most of these soils; however, some of the soils, such as the Columbia and Holillipah soils, are too sandy to impound water.

Soils in basins and on basin rims.—These soils have fair potential for development of openland wildlife habitat. The main limitation is the high shrink-swell potential, which affects the growth and diversity of trees and shrubs in nonirrigated areas. Trees and shrubs provide important food and cover for openland wildlife. Irrigated cropland on these soils can provide food, water, and seasonal cover if managed properly. Irrigation ditches, drainage ditches, and vegetated odd areas provide year-round hiding, resting, and nesting habitat.

There is good potential for development of wetland habitat on these soils if sufficient water is available. The Clear Lake and Capay soils in these areas are ideally suited to the development of wetland because water is easily impounded on them.

Since the late 1800's, these soils have been used for the production of winter wildlife habitat. Maintaining plants that provide food for waterfowl and controlling flooding in winter are needed. Some acreage is managed for both wintering waterfowl and wetland nesting habitat for resident waterfowl. Also, some areas of these soils are used for rice production in summer and are flooded after harvest to attract wetland wildlife.

Soils on terraces.—These soils have good to fair potential for development of openland habitat for wildlife. The main limitation on the Tisdale, San Joaquin, and Cometa soils is the low available water capacity, which limits the diversity and production of shrubs that provide food and cover. The Conejo soils have no limitations for the development of openland habitat. Irrigated cropland on these soils provides food, water, and seasonal cover if managed properly. Irrigation ditches, drainage ditches, and vegetated odd areas provide year-round hiding, resting, and nesting habitat.

If sufficient quantities of water are available, these soils can easily be developed for wetland habitat. Some areas of the San Joaquin and Cometa soils are used for rice production in summer and are flooded after harvest to attract wetland wildlife.

Soils on the mountains, hills, and alluvial fans in the Sutter Buttes.—These soils, with the exception of the Ocraig soils, have good to fair potential for development of rangeland wildlife habitat. The main limitations are the low available water capacity of the Ocraig, Palls, Dibble, and Stohlman soils and the high shrink-swell potential of the Altamont soils. These limitations restrict the growth of shrubs that provide food and cover for rangeland wildlife. The Bohna Variant soils have no major limitation for use as rangeland wildlife habitat. Management of wildlife habitat on these soils consists mainly of maintaining the existing habitat. The development of watering facilities, such as small ponds and guzzlers, is suited to the Bohna Variant and Palls soils.

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

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

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

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, wheatgrass, clover, trefoil, and alfalfa.

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

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are willow, cottonwood, ash, valley oak, sycamore, alder, and bay.

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 blackberry, wild rose, poison-oak, coyotebrush, raspberry, and wild grape.

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, saltgrass, rushes, sedges, and cattail.

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

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

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include California 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, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bobcat.

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, and muskrat.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, meadowlark, golden eagle, red-tailed hawk, and wild pig.

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. See Appendix for the specific criteria used to determine soil limitations.

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

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

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

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

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

The information in the tables, along with the soil maps and 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 8 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 the depth to the water table.

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

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

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 9 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 because of rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to 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 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 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 10, 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 as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an *improbable* source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

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

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

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

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

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

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

Water Management

Table 11 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. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

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

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

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

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features listed in tables are explained on the following pages.

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

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

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

Engineering Index Properties

Table 12 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

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

Classification of the soils is determined according to the system adopted by the American Association of State Highway and Transportation Officials (*1*) and the Unified soil classification system (*2, 11*).

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

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

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

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

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

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

Physical and Chemical Properties

Table 13 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

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

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

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, very fine sand, sand, and organic matter (up to 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 13, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 14 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potenital) when thoroughly wet. These consist chiefly of clay that has high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflow from streams and by runoff from adjacent slopes. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered to be flooding. Standing water in swamps and marshes or in closed depressional areas is considered to be ponding.

Table 14 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable period of flooding are estimated. Frequency is expressed as *none, rare, occasional,* frequent. *None* means that flooding is not probable, *rare* that it is unlikely but is possible under unusual weather conditions (chance of flooding in any year is 0 to 5 percent), *occasional* that it occurs infrequently under normal weather conditions (chance of flooding in any year is 5 to 50 percent), and *frequent* that it occurs often under normal weather conditions (chance of flooding in any year is more than 50 percent).

Duration is expressed as *very brief* (less than 2 days), *brief* (2to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that flooding is most likely to occur is expressed in months. November-May, for example, means that flooding can occur during the period November through May. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table K are the depth to the seasonal high water table; the kind of water table—that is, *perched, artesian,* or *apparent*; and the months of the year that the water table usually is highest. A water table that is seasonally high for less than 1 month is not indicated in the table.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An *artesian* water table is under hydrostatic head, generally below an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower water table by a dry zone.

The two numbers in the column "High water table" indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that the water table exists for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

A cemented pan is a cemented or indurated subsurface layer at a depth of 5 feet or less. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A *thin* pan is one that is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A *thick* pan is one that is more than 3 inches thick if continuously indurated or more than 18 inches thick if it is discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*17*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 15 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll (*Xer*, meaning dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploxerolls (*Hapl*, meaning minimal horizonation, plus *xeroll*, the suborder of the Mollisols that have a xeric moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haploxerolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, thermic, Typic Haploxerolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Taxonomic Units and Their Morphology

In this section, each taxonomic unit recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each taxonomic unit. A pedon, a small three-dimensional area of soil, that is typical of the unit in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*15*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*17*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the unit.

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

Altamont Series

The Altamont series consists of deep, well drained soils on hills. These soils formed in residuum derived from weathered shale. Slope is 9 to 50 percent.

Soils of the Altamont series are fine, montmorillonitic, thermic Typic Chromoxererts.

Typical pedon of an Altamont silty clay in an area of Altamont-Dibble complex, 9 to 30 percent slopes, 1,150 feet north and 1,400 feet east of the southwest corner of sec. 35, T. 16 N., R. 1 E., Sutter Buttes quadrangle.

A1—0 to 4 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; strong medium subangular blocky structure; extremely hard, very firm, very sticky and plastic; common very fine roots; few very fine interstitial pores; cracks 1 centimeter wide; neutral; clear wavy boundary.

A2—4 to 27 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; moderate coarse subangular blocky structure; extremely hard, very firm, very sticky and plastic; common very fine roots; few very fine interstitial pores; many slickensides; cracks 1 centimeter wide extend to a depth of 23 inches; moderately alkaline; clear smooth boundary.

Bk1—27 to 44 inches; yellowish brown (10YR 5/4) silty clay, dark brown (10YR 3/3) moist; massive; extremely hard, very firm, very sticky and plastic; few very fine roots; few very fine tubular pores; 15 percent soft shale fragments; many slickensides; disseminated lime; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—44 to 52 inches; yellowish brown (10YR 5/4) silty clay loam, brown (10YR 5/3) moist; massive; extremely hard, very firm, sticky and plastic; few very fine roots; few very fine tubular pores; 50 percent soft shale fragments; disseminated lime; violently effervescent; moderately alkaline; gradual smooth boundary.

Cr—52 inches; light brownish gray (2.5Y 6/2) shale, grayish brown (2.5Y 5/2) moist; massive; disseminated lime coating rock fragments; violently effervescent.

Depth to paralithic contact of shale or sandstone is 40 to 60 inches. The profile is 35 to 60 percent clay. Cracks more than 1 centimeter wide extend to a depth of 23 inches or more. The cracks close in November or December, remain closed until April or May, and then are open the rest of the year. Mean annual soil temperature ranges from 62 to 65 degrees F.

The A horizon has dry color of lOYR 5/2 or 5/3 and moist color of 10YR 3/2 or 3/3.

The B horizon has dry color of 10YR 5/4 or 6/4 or of 2.5Y 5/4, 6/2, or 5/2, and it has moist color of 10YR 4/3, 5/4, or 3/3 or of 2.5Y 5/2. It is silty clay loam or silty clay. It is slightly effervescent to violently effervescent.

Arents

Arents are deep to very deep, well drained, altered soils on terraces. These soils consist of cut and fill material deposited during land leveling. The original material was alluvium derived from mixed sources, mainly granite. Slope is 0 to 1 percent.

Reference pedon of Arents in an area of San Joaquin-Arents-Durochrepts complex, 0 to 1 percent slopes, 450 feet south and 4,130 feet west of the northeast corner of sec. 12, T. 10 N., R. 4 E., Rio Linda quadrangle.

Ap—0 to 6 inches; mixed soil material; about 60 percent is light yellowish brown (10YR 6/4) sandy loam and sandy clay loam, dark yellowish brown (10YR 4/4) moist; about 20 percent is light yellowish brown (10YR 6/4) gravel-sized duripan fragments, and about 20 percent is mixed gray (10YR 5/1) and light brown (7.5YR 6/4) clay fragments, dark gray (10YR 4/1) and brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; many thin clay films on pores and pressure faces on clay fragments; mixing is variable with no pattern; neutral; clear smooth boundary.

C—6 to 48 inches; mixed soil material; about 80 percent is light yellowish brown (10YR 6/4) and strong brown (7.5YR 5/6) sandy clay loam, yellowish brown (10YR 5/4) and strong brown (7.5YR 4/6) moist; about 10 percent is dark gray (10YR 4/1) clay fragments and about 10 percent is light yellowish brown (10YR 6/4) gravel-sized duripan fragments; massive; slightly hard, friable, sticky and plastic; pressure faces on clay fragments; mixing is variable, with no pattern; neutral; abrupt wavy boundary.

2Ab—48 to 56 inches; brown (7.5YR 4/4) sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; few very fine interstitial pores; slightly acid; abrupt smooth boundary.

2Btb—56 to 61 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; massive; very hard, firm, sticky and plastic; slightly acid.

Content of gravel-sized duripan fragments ranges from 10 to 40 percent. Reaction is slightly acid to neutral. Depth to a buried soil ranges from 20 to 60 inches.

The Ap horizon has dominant dry color of 10YR 6/4 or 5/4, 7.5YR 6/4, or 7.5YR 5/6 and moist color of 10YR 4/4 or 5/4 or of 7.5YR 4/6 or 3/4. It is sandy loam, loam, or sandy clay loam. Clay content ranges from 10 to 35 percent.

The C horizon has dominant dry color of 10YR 5/4 or 6/4 or of 7.5YR 5/6, and it has moist color of 10YR 4/4 or 5/4 or of 7.5YR 4/6. It is mixed clay, sandy clay loam, loam, and sandy loam. Sandy clay loam is normally dominant. Clay content ranges from 10 to 35 percent.

The 2Ab horizon is sandy loam or loam. It is 10 to 20 percent clay.

The 2Btb horizon is silty clay or clay. It is 40 to 50 percent clay.

Bohna Variant

The Bohna Variant consists of very deep, well drained soils on mountains. These soils formed in colluvium derived from extrusive igneous rock. Slope is 30 to 60 percent.

Soils of the Bohna Variant are fine-loamy, mixed, thermic Typic Argixerolls.

Typical pedon of a Bohna Variant sandy loam in an area of Palls-Bohna Variant association, 30 to 60 percent slopes, steep, 2,200 feet north and 1,450 feet east of the southwest corner of sec. 19, T. 16 N., R. 2 E., Sutter Buttes quadrangle.

A—0 to 7 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common very fine and few fine roots; many very fine and fine tubular pores and many very fine interstitial pores; slightly acid; clear smooth boundary.

BAt—7 to 13 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many fine tubular pores; common thin clay films in pores; slightly acid; clear wavy boundary.

Bt1—13 to 41 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate coarse subangular blocky structure; hard, friable, sticky and plastic; common very fine and few fine and medium roots; many fine tubular pores; many thin clay films on peds and in pores; slightly acid; clear wavy boundary.

Bt2—41 to 62 inches; brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 3/4) moist; strong medium subangular blocky structure; extremely hard, firm, sticky and plastic; few very fine and fine and common coarse roots; many very fine tubular pores; many moderately thick clay films on peds and in pores; slightly acid.

The mean annual soil temperature is 60 to 64 degrees F. The soil moisture control section is dry in all parts from June to October and is moist in some or all parts from November to May.

The A horizon has dry color of 10YR 5/2, 5/3, 4/2, or 4/3 and moist color of 10YR 3/2 or 3/3. It is 15 to 20 percent clay.

The Bt horizon has dry color of 10YR 5/3, 5/4, or 4/4 or of 7.5 YR 5/4, 4/4, or 4/6, and it has moist color of 10YR 4/4, 4/6, or 3/3 or of 7.5YR 4/3, 4/4, 4/6, or 3/4. It is 20 to 35 percent clay.

Some pedons have a C horizon.

Byington Series

The Byington series consists of very deep, poorly drained soils on flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Byington series are fine-silty, mixed (calcareous), thermic Aeric Fluvaquents.

Typical pedon of Byington silt loam, 0 to 2 percent slopes, 1,000 feet west and 3,050 feet north of the southeast corner of sec. 21, T. 12 N., R. 2 E., Knights Landing quadrangle.

Apl—0 to 8 inches; light olive gray (5Y 6/2) silt loam, dark olive gray (5Y 3/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; common very fine roots; many very fine tubular pores; strongly alkaline; clear smooth boundary.

Ap2—8 to 13 inches; light olive gray (5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, friable, sticky and slightly plastic; few very fine roots; many very fine tubular pores; disseminated lime; slightly effervescent; very strongly alkaline; abrupt smooth boundary.

C1—13 to 20 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; common medium faint dark yellowish brown (10YR 4/6) mottles; dark yellowish brown (10YR 4/4) moist; massive; hard, friable, sticky and slightly plastic; few very fine tubular pores; disseminated lime; slightly effervescent; very strongly alkaline; abrupt smooth boundary.

C2—20 to 26 inches; olive gray (5Y 5/2) silty clay loam, black (5Y 2.5/2) moist; massive; hard, friable, sticky and slightly plastic; common very fine and fine tubular pores; slightly effervescent; very strongly alkaline; disseminated lime; abrupt smooth boundary.

C3—26 to 42 inches; light yellowish brown (2.5Y 6/4) silt loam, dark grayish brown (2.5Y 4/2) moist; common medium faint dark gray (10YR 4/1) and grayish brown (2.5Y 5/2) mottles; massive; slightly hard, very friable, slightly sticky and nonplastic; common very fine and fine tubular pores; disseminated lime; slightly effervescent; very strongly alkaline; clear smooth boundary.

C4—42 to 62 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; common medium distinct yellowish brown (10YR 5/6) mottles and many fine prominent dark brown (7.5YR 4/4) and grayish brown (2.5Y 5/2) mottles moist, with gray (10YR 5/1) mottles lining pores; massive; slightly hard, very friable, slightly sticky and nonplastic; common very fine tubular pores; disseminated lime; slightly effervescent; moderately alkaline.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June to November in areas not irrigated and is moist the rest of the year.

The 10- to 40-inch control section is stratified silt loam, silty clay loam, and very fine sandy loam and is less than 15 percent sand that is fine or coarser. Clay content ranges from 18 to 30 percent. Content of organic matter decreases irregularly with depth. Reaction is moderately alkaline to very strongly alkaline.

The A horizon has dry color of 10YR 6/2, 2.5Y 6/2, or 5/2, or 5Y 6/2 and moist color of 10YR 3/2, 2.5Y 4/2 or 3/2, or 5Y 3/2.

The C horizon has dry color of 10YR 6/3, 2.5Y 7/2, 6/2, or 6/4, or 5Y 5/2 and moist color of 10YR 4/2, 2.5Y 5/2, 4/2, or 3/2, or 5Y 2.5/2.

Capay Series

The Capay series consists of deep and very deep, moderately well drained soils in basins and on basin rims. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Capay series are fine, montmorillonitic, thermic Typic Chromoxererts.

Typical pedon of Capay silty clay, 0 to 2 percent slopes, 1,100 feet west and 2,300 feet south of the northeast corner of sec. 29, T. 12 N., R. 4 E., Verona quadrangle.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; strong coarse granular structure; very hard, very firm, sticky and plastic; many very fine roots; few very fine tubular pores; neutral; clear wavy boundary.

A1—8 to 21 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse prismatic structure; very hard, very firm, sticky and plastic; common very fine roots; many very fine tubular pores; common intersecting slickensides; cracks 1 to 2 centimeters wide; mildly alkaline; gradual wavy boundary.

A2—21 to 36 inches; dark grayish brown (10YR 4/2) silty clay, dark brown (10YR 3/3) moist; strong coarse angular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; few very fine tubular pores; common intersecting slickensides; cracks 1 to 2 centimeters wide; common fine manganese concretions; disseminated lime; slightly effervescent; moderately alkaline; gradual wavy boundary.

Ckl—36 to 48 inches; brown (10YR 5/3) clay loam, dark yellowish brown (10YR 3/4) moist; moderate medium and coarse subangular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; many very fine tubular pores; common intersecting slickensides; cracks 1 to 2 centimeters wide; common fine manganese concretions; filaments and seams of lime; violently effervescent; moderately alkaline; clear wavy boundary.

Ck2—48 to 58 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; common medium and coarse subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; many very fine and fine and few coarse tubular pores; violently effervescent; moderately alkaline; common fine manganese concretions; clear wavy boundary; filaments and seams of lime.

C—58 to 72 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak fine, medium, and coarse subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; disseminated lime; slightly effervescent; moderately alkaline.

Depth to siltstone or to the duripan ranges from 40 inches to more than 60 inches. The profile is 35 to 60 percent clay. It has cracks 1 centimeter or more wide that extend to a depth of 25 inches or more. They are open from June to October in areas not irrigated and are closed the rest of the year. The mean annual soil temperature is 62 to 65 degrees F. Depth to lime commonly is more than 20 inches.

The A horizon has dry color of 10YR 5/2, 4/2, 3/2, 5/3, or 4/3 and moist color of 10YR 4/2, 4/3, 4/4, 3/2, or 3/3. Texture is clay or silty clay. The horizon is neutral to moderately alkaline, becoming more alkaline as depth increases.

The C horizon has dry color of 10YR 6/4, 6/3, 5/3, 5/4, or 5/2 and moist color of 10YR 5/4, 4/2, 4/3, 4/4, or 3/4. It is clay, silty clay, or clay loam. Lime is in the form of hard concretions and soft masses and is disseminated throughout the horizon.

Some pedons have a layer of loam below the duripan.

Clear Lake Series

The Clear Lake series consists of deep and very deep, poorly drained soils in basins. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Clear Lake series are fine, montmorillonitic, thermic Typic Pelloxererts.

Typical pedon of Clear Lake clay, 0 to 2 percent slopes, 2,490 feet north and 100 feet east of the southwest corner of sec. 29, T. 12 N., R. 3 E., Knights Landing quadrangle.

Ap—0 to 10 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; few fine prominent strong brown (7.5YR 5/6) mottles; strong medium and coarse angular blocky structure; very hard, firm, very sticky and plastic; few very fine and fine roots; common very fine and fine interstitial and tubular pores; neutral; clear wavy boundary.

A1—10 to 25 inches; dark gray (5Y 4/1) clay, black (5Y 2.5/1) moist; strong coarse angular blocky structure; very hard, firm, very sticky and plastic; few fine roots; common very fine tubular pores; few fine rounded manganese concretions; many pressure faces; moderately alkaline; clear wavy boundary.

A2—25 to 42 inches; dark gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; strong coarse angular blocky structure; very hard, firm, very sticky and plastic; few very fine roots; many very fine tubular pores; few fine manganese concretions; many slickensides; moderately alkaline; gradual wavy boundary.

C—42 to 68 inches; olive gray (5Y 5/2) clay, dark olive gray (5Y 3/2) moist; strong medium and coarse angular blocky structure; very hard, firm, very sticky and plastic; few very fine roots; many very fine tubular pores; few fine rounded manganese concretions; many slickensides; moderately alkaline.

Depth to siltstone or to the duripan ranges from 40 inches to more than 60 inches. The profile is 40 to 55 percent clay. Cracks 1 centimeter wide or more extend to a depth of 25 inches or more and are open from June to October in areas not irrigated and are closed the rest of the year. The mean annual soil temperature is 62 to 65 degrees F. Reaction is neutral to moderately alkaline

The A horizon has dry color of 10YR 4/1 or 3/1 or 5Y 4/1 and moist color of 10YR 3/1 or 2/1, 5Y 3/1, or 2.5/1.

The C horizon is clay, sandy clay, silty clay, silty clay loam, or clay loam. It has dry color of 10YR 6/4, 6/3, 5/2, or 5/3 or 5Y 5/2 or 5/1 and moist color of 10YR 5/4, 4/2, 4/3, or 3/2 or 5Y 3/2.

Some pedons have have 8 to 15 inches of silt loam overwash.

Columbia Series

The Columbia series consists of very deep, somewhat poorly drained soils on flood plains (fig. 5). These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Columbia series are coarse-loamy, mixed, nonacid, thermic Aquic Xerofluvents.

Typical pedon of Columbia fine sandy loam, frequently flooded, 0 to 2 percent slopes, 2,500 feet south and 4,900 feet east of the intersection of Rivera Road and Meteer Road. About 300 feet from the Feather River in the Boga Land Grant, T. 17 N., R. 3 E. (not sectionized), Gridley quadrangle.

Ap—0 to 10 inches; pale brown, (10YR 6/3) fine sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; common very fine interstitial pores; neutral, clear smooth boundary.

A—10 to 14 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots, common coarse and very fine tubular pores, neutral; abrupt wavy boundary.

C1—14 to 19 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 3/3) moist; massive; loose,

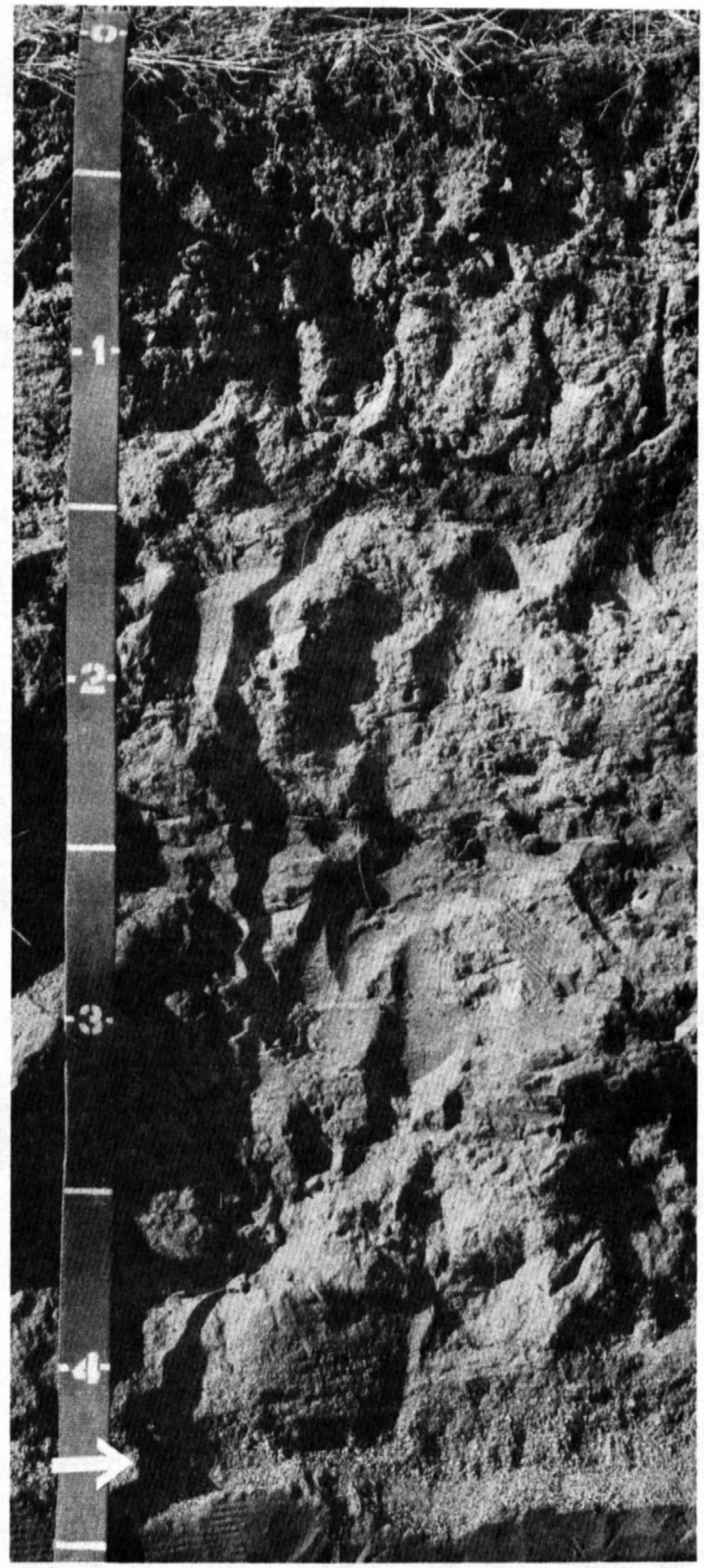

Figure 5.—Profile of Columbia loam, 0 to 2 percent slopes. Dark layers at a depth of 1.5 and 2.5 feet represent an original land surface covered by flooding. Arrow points to layer of sand.

very friable, nonsticky and nonplastic; many very fine interstitial pores; neutral; abrupt smooth boundary.

C2—19 to 33 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic, few fine and common coarse roots; few coarse tubular pores; neutral; abrupt wavy boundary.

C3—33 to 38 inches; light yellowish brown (10YR 6/4) fine sandy loam, dark brown (10YR 3/3) moist; common medium distinct strong brown (7.5YR 5/6) mottles; massive; loose, very friable, nonsticky and nonplastic; few fine and common coarse roots; few coarse tubular pores; neutral; abrupt smooth boundary.

C4—38 to 68 inches; light yellowish brown (10YR 6/4) very fine sandy loam, dark brown (10YR 3/3) moist; common medium distinct strong brown (7.5YR 5/6) mottles; massive; soft, very friable, nonsticky and nonplastic; few fine and common coarse roots; few fine tubular pores; mildly alkaline.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section in areas not irrigated becomes dry late in May or in June and is continuously dry until some time in October. The rest of the year some or all of the profile is moist. Mottles are within 10 to 34 inches of the surface. Stratification is weak to distinct, and strata of contrasting textures 0.25 to 5.0 inches thick are present in some pedons. Average clay content of the 10- to 40-inch control section is 10 to 18 percent, 68 to 70 percent of which is fine or coarser. Texture is stratified layers of fine sandy loam, very fine sandy loam, silt loam, loam, or loamy sand. Organic matter content decreases irregularly with depth.

The A horizon has dry color of 10YR 7/4, 7/2, 6/2, 6/3, 5/3, or 6/4 and moist color of 10YR 4/2, 4/3, 4/4, or 3/3. It is loam or fine sandy loam.

The C horizon has dry color of 10YR 7/4, 7/2, 6/2, 6/3, or 6/4 and moist color of 10YR 5/2, 5/4, 4/3, 4/4, or 3/3. In some pedons there is a buried clay, silty clay, silty clay loam, or clay loam layer at a depth of 40 to 60 inches.

Cometa Series

The Cometa series consists of very deep, well drained soils on terraces. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Cometa series are fine, mixed, thermic Typic Palexeralfs.

Typical pedon of Cometa loam, 0 to 2 percent slopes, 1,600 feet west, 2,500 feet north of the southeast corner of sec. 33, T. 13 N., R. 4 E., Nicolaus quadrangle.

Ap—0 to 7 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist, many fine distinct yellowish red (5YR 5/6) mottles; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine interstitial and tubular pores; medium acid; abrupt wavy boundary.

A—7 to 16 inches; brown (7.5YR 5/4) loam, brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common fine and very fine tubular pores; neutral; abrupt smooth boundary.

Bt—16 to 34 inches; strong brown (7.5YR 4/6) clay, yellowish red (5YR 4/6) moist; massive; very hard, very firm, very sticky and very plastic; common very fine tubular pores; many pressure faces on peds; common fine manganese concretions; neutral; clear wavy boundary.

BC—34 to 62 inches; yellowish red (5YR 4/6) clay loam yellowish red (5YR 4/6) moist; massive; very hard, firm, sticky and plastic; many fine manganese concretions and strains; semiconsolidated; neutral.

The mean annual soil temperature is about 62 to 65 degrees F. The soil usually is moist all of the time from November until late in May or early in June and is dry in some or all parts the rest of the year in areas not irrigated.

The A horizon has dry color of 10YR 6/3 or 5/4 or 7.5YR 5/4 and moist color of 10YR 4/3, 3/3, or 3/4 or 7.5YR 5/4, 4/4, 4/6, or 3/4. Reaction is medium acid or neutral. Clay content ranges from 18 to 25 percent.

The Bt horizon has dry color of 7.5YR 4/4 or 4/6 or 5YR 5/4 and moist color of 7.5 4/4 or 4/6 or 5YR 4/4 or 4/6. Clay content ranges from 40 to 50 percent. The upper 1 inch of the Bt horizon has 15 percent (absolute) more clay than the A horizon.

The BC horizon has dry color of 7.5YR 5/6 or 4/6 or 5YR 4/6 and moist color of 7.5YR 5/6 or 4/6 or 5YR 4/6.

Some pedons have a C horizon.

Conejo Series

The Conejo series consists of deep and very deep, well drained soils on low terraces. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Conejo series are fine-loamy, mixed, thermic Pachic Haploxerolls.

Typical pedon of Conejo loam, 0 to 2 percent slopes (fig. 6), 1,300 feet north and 1,000 feet east of the southwest corner of sec. 5, T. 14 N., R. 3 E., Gilsizer Slough quadrangle.

Ap—0 to 7 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; few very fine and common coarse roots; many very fine tubular pores; neutral; clear wavy boundary.

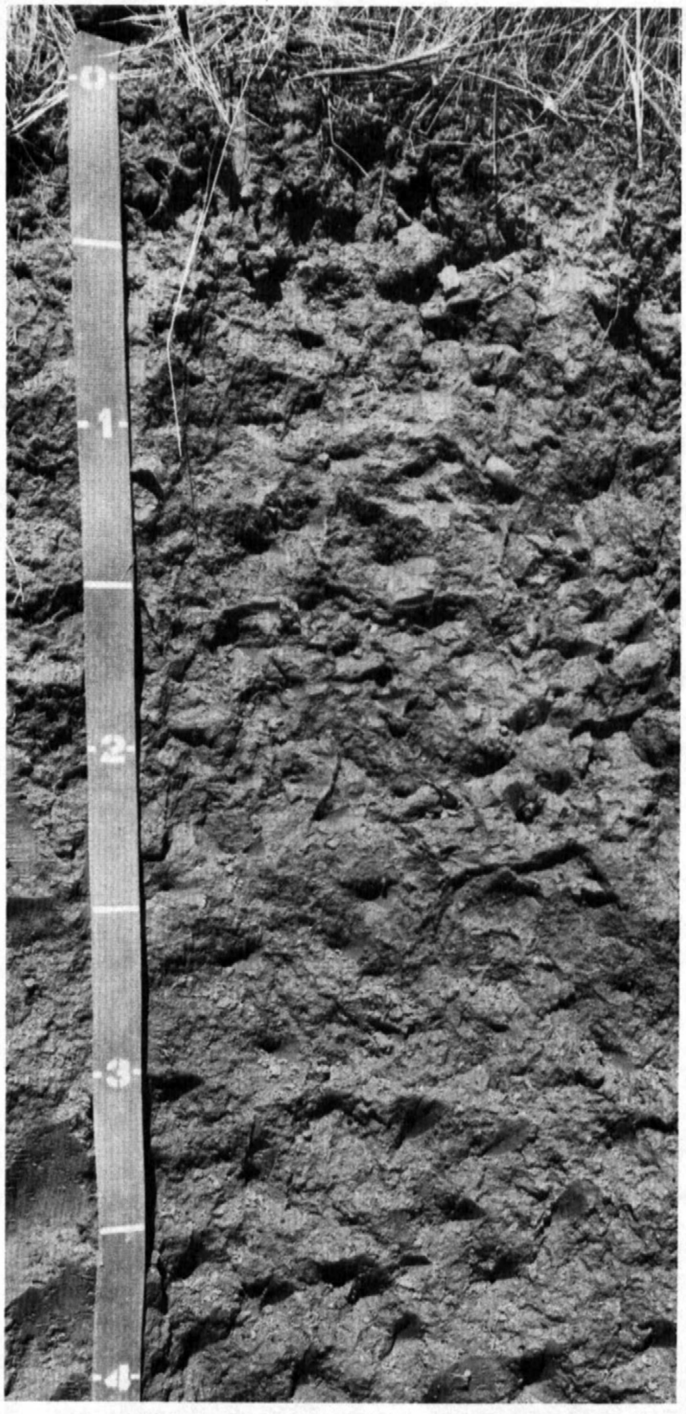

Figure 6.—Profile of Conejo loam, 0 to 2 percent slopes.

Bt—7 to 30 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and plastic; few very fine and common coarse roots; many very fine and fine tubular pores; common thin clay films in pores and bridging sand grains; moderately alkaline; gradual wavy boundary.

C—30 to 62 inches; pale brown (10YR 6/3) loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; few fine and medium roots; many very fine and fine tubular pores; moderately alkaline.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is moist late in October or early in November and remains continuously moist until May or early in June. It is dry the rest of the year in areas not irrigated. The profile 20 to 35 percent clay.

The A horizon has dry color of 10YR 5/2 or 5/3 and moist color of 10YR 3/2 or 3/3. Reaction is slightly acid to mildly alkaline.

The B horizon has dry color of 10YR 6/3, 5/3, 4/3, or 5/4 and moist color of 10YR 4/3, 3/3, 3/2, or 3/4. It is loam or clay loam that has 1 to 3 percent (absolute) more clay than the A horizion. Reaction is slightly acid to moderately alkaline.

The C horizon has dry color of 10YR 7/3, 7/4, 6/3, 6/4, or 5/4 and moist color of 10YR 5/4, 5/6, 4/3, 4/4, or 4/6. Texture is loam or clay loam. Reaction is mildly alkaline or moderately alkaline.

Dibble Series

The Dibble series consists of moderately deep, well drained soils on hills. These soils formed in residuum derived from sandstone and shale. Slope is 9 to 50 percent.

Soils of the Dibble series are fine, montmorillonitic, thermic Typic Haploxeralfs.

Typical pedon of Dibble silty clay loam in an area of Altamont-Dibble complex, 9 to 30 percent slopes, 1,350 feet north and 1,400 feet east of the southwest corner of sec. 35, T. 16 N., R. 1 E., Sutter Buttes quadrangle.

A—0 to 5 inches, light yellowish brown (10YR 6/4) silty clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, friable, sticky and slightly plastic; few very fine roots; common very fine interstitial and tubular pores; slightly acid; clear smooth boundary.

Bt—5 to 16 inches; brownish yellow (10YR 6/6) clay, yellowish brown (10YR 5/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, very friable, sticky and plastic; common very fine roots; common very fine tubular pores; many thin clay films on peds and in pores; neutral; clear wavy boundary.

C—16 to 22 inches; yellow (10YR 7/6) clay, yellowish brown (10YR 5/4) moist; massive; hard, very friable, sticky and plastic; common very fine roots; common very fine tubular pores; 30 percent pebbles that are easily crushed; neutral; gradual wavy boundary.

Cr—22 inches; weathered interbedded sandstone and shale.

Depth to paralithic contact of sedimentary rock is 20 to 40 inches. The mean annual soil temperature is about 62 to 65 degrees F. The soil moisture control section is moist all of the time in some or all parts from about November until about May and usually is dry the rest of the time.

The A horizon has dry color of 10YR 6/3 or 6/4 and moist color of 10YR 4/3 or 4/4.

The Bt horizon has dry color of 10YR 6/3, 6/4, or 6/6 and moist color of 10YR 5/4 or 4/3.

The C horizon has 15 to 30 percent soft gravel that is easily crushed.

Durochrepts

Durochrepts are shallow and very shallow, well drained, altered soils on terraces. These soils consist of cut and fill material deposited during land leveling, as well as material from a ripped duripan. The original material was alluvium derived from mixed sources, mainly granite. Slope is 0 to 1 percent.

Reference pedon of Durochrepts in an area of San Joaquin-Arents-Durochrepts complex, 0 to 1 percent slopes, 250 feet south and 2,750 feet west of the northeast corner of sec. 12, T. 10 N., R. 4 E., Rio Linda quadrangle.

Ap—0 to 6 inches; mixed soil material; about 70 percent is light yellowish brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; about 25 percent is light yellowish brown (10YR 6/4) gravel-sized duripan fragments, and about 5 percent is gray (10YR 5/1) clay fragments with pressure faces; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; mixing is variable, with no pattern; mildly alkaline; clear smooth boundary.

C—6 to 16 inches; mixed soil material; about 60 percent is very pale brown (10YR 7/4) sandy loam, yellowish brown (10YR 5/4) moist; about 40 percent is gravel-sized duripan fragments; massive; soft, very friable, nonsticky and nonplastic; mixing is variable, with no pattern; mildly alkaline; clear irregular boundary.

Cqm—16 inches; very pale brown (10YR 7/4) duripan, yellowish brown (10YR 5/4) moist; massive; extremely hard, continuous, and indurated with silica and carbonates; upper part is grooved by ripping.

Depth to the duripan ranges from 5 to 20 inches. The profile is neutral or mildly alkaline. It is 10 to 35 percent clay. Content of gravel-sized duripan fragments ranges from 20 to 60 percent. Texture is sandy loam, loam, or sandy clay loam.

Exeter Series

The Exeter series consists of moderately deep, well drained soils on terraces. These soils formed in alluvium derived from mixed sources, mainly granite. Slope is 0 to 2 percent.

Soils of the Exeter series are fine-loamy, mixed, thermic Typic Durixeralfs.

Typical pedon of Exeter sandy loam, 0 to 2 percent slopes (fig. 7), 100 feet north and 350 feet east of the southwest corner of sec. 36, T. 11 N., R. 4 E., Pleasent Grove quadrangle.

Ap—0 to 9 inches; pink (7.5YR 7/4) sandy clay loam, brown (7.5YR 4/4) moist; many very fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, very friable, nonsticky and nonplastic; few very fine roots; many very fine tubular pores; neutral abrupt smooth boundary.

Btl—9 to 15 inches; reddish yellow (7.5YR 6/6) sandy loam, strong brown (7.5YR 4/6) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine tubular pores; common thin clay films bridging sand grains; many medium rounded manganese concretions; neutral; clear smooth boundary.

Bt2—15 to 23 inches; strong brown (7.5YR 5/6) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; very hard, friable, sticky and slightly plastic; few very fine and fine roots; many very fine and fine tubular pores; many moderately thick clay films on peds and lining pores; many medium rounded manganese concretions; neutral; clear smooth boundary.

Bt3—23 to 27 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 4/6) moist; moderate medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine tubular pores; many moderately thick clay films on peds and lining pores; many medium rounded manganese concretions; mildly alkaline; abrupt smooth boundary.

Bt4—27 to 30 inches; brown (7.5YR 5/4) sandy clay loam, brown (7.5YR 4/4) moist; moderate medium prismatic structure; very hard, friable, sticky and plastic; few very fine and fine roots; common very fine and fine tubular pores; pressure faces; many medium rounded manganese concretions; mildly alkaline; abrupt smooth boundary.

Cqm—30 to 50 inches; dark yellowish brown (10YR 4/4) duripan; massive; extremely hard, very firm;

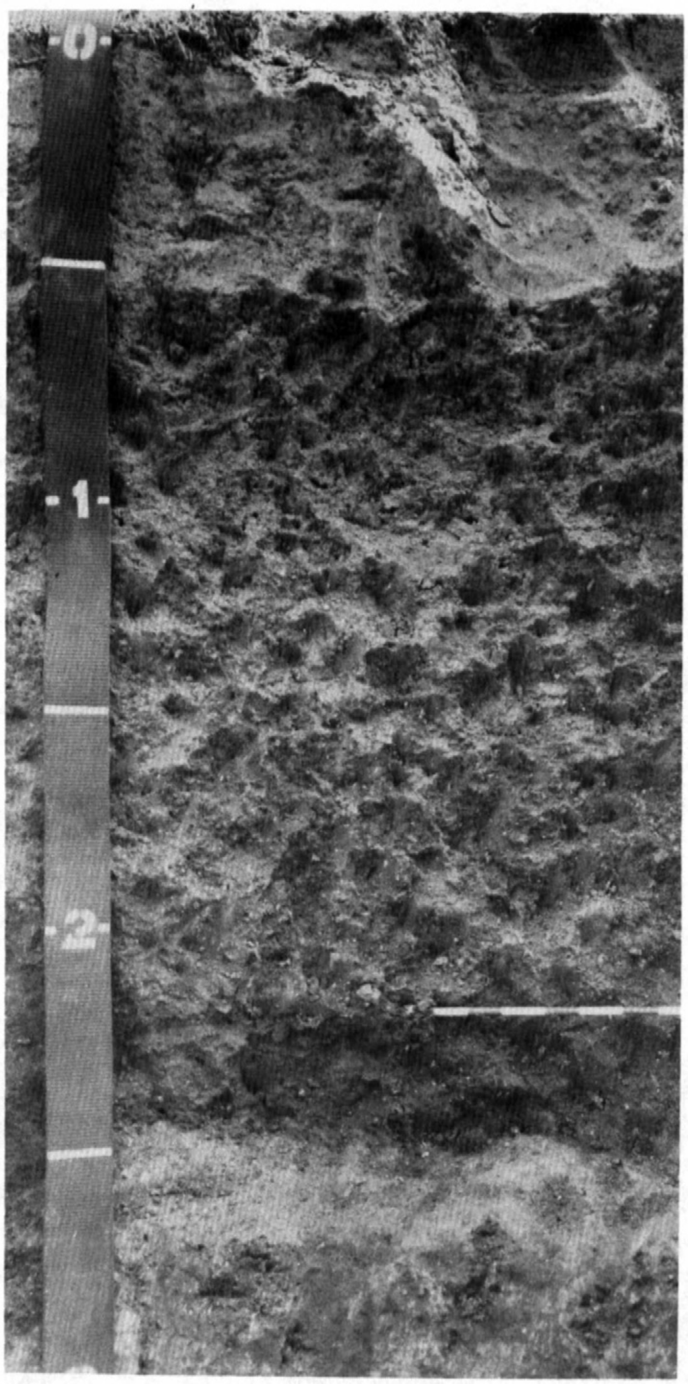

Figure 7.—Profile of Exeter sandy loam, 0 to 2 percent slopes. Duripan is at a depth of 2.5 feet.

continuously indurated with silica and capped by a discontinuous laminar silica cap 1 millimeter thick.

Cq—50 to 60 inches; dark yellowish brown (10YR 4/4) sandy loam; massive; hard, friable, nonsticky and nonplastic; weakly cemented by silica; mildly alkaline.

Depth to the duripan is 20 to 40 inches. The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section usually is dry all of the time from about June to November unless irrigated and is moist in some or all parts the rest of the year.

The A horizon has dry color of 7.5YR 7/4 or 6/4 and moist color of 7.5YR 5/4, 4/4, or 3/4. Clay content ranges from 10 to 18 percent.

The Bt horizon has dry color of 7.5YR 6/6, 5/6, 4/6, or 5/4 and moist color of 7.5YR 4/6 or 4/4 or 5YR 4/4. Clay content ranges from 22 to 35 percent.

The C horizon is continuously indurated in the upper part and becomes less cemented with depth.

Galt Series

The Galt series consists of moderately deep, moderately well drained soils on basin rims. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Galt series are fine, montmorillonitic, thermic Typic Chromoxererts.

Typical pedon of Galt clay, 0 to 2 percent slopes, 700 feet west and 150 feet north from the southeast corner of sec. 20, T. 11 N., R. 4 E., Verona quadrangle.

Ap—0 to 5 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; very hard, firm, very sticky and plastic; common very fine and fine roots; few very fine and fine tubular pores; moderately alkaline; abrupt smooth boundary.

A—5 to 10 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; massive; very hard, firm, very sticky and plastic; common very fine roots; few very fine and fine tubular pores; many slickensides that intersect; few fine rounded manganese concretions; moderately alkaline; clear smooth boundary.

Ck—10 to 21 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) and dark yellowish brown (10YR 4/4) moist; massive; very hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; many slickensides that intersect; few fine rounded manganese concretions; disseminated lime; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ckq—21 to 23 inches; pale brown (10YR 6/3) duripan, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine tubular pores; few fine rounded manganese concretions; disseminated lime; weakly cemented with silica; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ckqm—23 to 28 inches; mixed very pale brown (10YR 7/4) and yellowish brown (10YR 5/4) duripan, dark yellowish brown (10YR 4/4) moist; massive; very hard, indurated with silica and iron; few very fine tubular pores; few fine rounded manganese concretions; disseminated lime and lime in seams; strongly effervescent; clear smooth boundary.

Cq—28 to 42 inches; very pale brown (10YR 7/4) duripan, yellowish brown (10YR 5/4) moist; massive; hard, weakly cemented with silica and iron; few very fine tubular pores; moderately alkaline; gradual wavy boundary.

C—42 to 62 inches; pale yellow (2.5Y 7/4) loam, yellowish brown (10YR 5/4) moist; common fine distinct strong brown (7.5YR 4/6) mottles; massive; slightly hard, friable, nonsticky and slightly plastic; few very fine tubular pores; weakly cemented with silica; moderately alkaline.

Depth to the duripan is 20 to 40 inches. Clay content in the control section is 40 to 60 percent. Cracks 1 to 2 centimeters wide extend to a depth of 21 inches or more and are open from June to October in areas not irrigated and are closed the rest of the year. The mean annual soil temperature is 62 to 65 degrees F.

The A horizon has dry color of 10YR 5/2, 5/3, or 4/2 and moist color of 10YR 3/2 or 3/3. Reaction is slightly acid or moderately alkaline.

The CK horizon has dry color of 10YR 6/2, 6/3, 5/2, 5/3, 3/3, 7/4, or 5/4 and moist color of 10YR 4/2, 4/3, 3/2, 3/3, or 4/4. Texture is clay or silty clay.

Galt Variant

The Galt Variant consists of moderately deep, somewhat poorly drained soils on flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Galt Variant are fine-loamy, mixed, thermic Typic Durochrepts.

Typical pedon of a Galt Variant clay loam in an area of Liveoak Variant-Galt Variant complex, frequently flooded, 0 to 2 percent slopes, 2,700 feet east and 350 feet south of the northwest corner of sec. 32, T. 17 N., R. 1 E., Sanborn Slough quadrangle.

A1—0 to 5 inches; light brownish gray (10YR 6/2) clay loam, dark brown (10YR 3/3) moist; strong fine granular structure; hard, friable, sticky and plastic; many very fine and fine and few medium tubular pores; disseminated lime; 8 percent calcium carbonate equivalent; slightly effervescent; neutral; clear wavy boundary.

A2—5 to 13 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 3/3) moist; strong medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine and fine and few medium tubular pores; disseminated lime; 8 percent calcium carbonate equivalent; slightly effervescent; moderately alkaline; clear smooth boundary.

Bw—13 to 17 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; strong medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine and fine and few medium tubular pores; disseminated lime; 7 percent calcium carbonate equivalent; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk—17 to 21 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; few very fine tubular pores; disseminated lime; 41 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; abrupt smooth boundary.

Ckqm—21 to 22 inches; white (10YR 8/2) duripan, light brownish gray (10YR 6/2) moist; massive; extremely hard; continuous laminar bands of silica and calcium carbonate; alternating seams of lime; violently effervescent; abrupt smooth boundary.

Ck—22 to 25 inches; very pale brown (10YR 8/3) loam, very pale brown (10YR 7/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; disseminated lime; 43 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; abrupt smooth boundary.

Ckqm—25 to 26 inches; white (10YR 8/2) duripan, light gray (10YR 7/2) moist; massive; extremely hard; continuous laminar bands of silica and calcium carbonate; alternating seams of lime; violently effervescent; abrupt smooth boundary.

2Cr—26 to 60 inches; white (10YR 8/2) siltstone, light olive brown (2.5Y 5/4) moist; massive; very hard, extremely firm; disseminated lime; violently effervescent.

Depth to a silica cemented indurated duripan ranges from 20 to 35 inches. The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June to October in areas not irrigated and is moist in some or all parts the rest of the year. Clay content in the control section ranges from 27 to 35 percent. Reaction is neutral to moderately alkaline.

The A horizon has dry color of 10YR 6/2 or 6/3 and moist color of 10YR 3/2, 3/3, or 4/3.

The B horizon has dry color of 10YR 6/2, 6/3, 7/3, or 6/4 and moist color of 10YR 5/3, 4/3, 4/4, 3/3, or 3/2.

The Ck horizon has dry color of 10YR 8/3, 7/3, 6/3, or 8/2 and moist color of 10YR 7/3, 6/3, 5/3, 7/2, or 6/2.

Garretson Variant

The Garretson Variant consists of very deep, well drained soils on terraces. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Garretson Variant are fine-loamy, mixed (calcareous), thermic Typic Xerorthents.

Typical pedon of Garretson Variant loam, 0 to 2 percent slope, 400 feet east and 1,750 feet south of the northwest corner of sec. 28, T. 14 N., R. 3 E., Gilsizer Slough quadrangle.

Ap—0 to 4 inches, light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium and coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; many very fine roots; few very fine and fine tubular pores; disseminated lime; slightly effervescent; moderately alkaline; clear wavy boundary.

A—4 to 8 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine and fine tubular pores; disseminated lime; slightly effervescent; moderately alkaline; clear wavy boundary.

Ak—8 to 15 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine and fine tubular pores; disseminated lime; violently effervescent; moderately alkaline; abrupt wavy boundary.

Bk1—15 to 21 inches; very pale brown (10YR 7/3) loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine and fine tubular pores; disseminated lime; violently effervescent; moderately alkaline; gradual wavy boundary.

Bk2—21 to 46 inches; very pale brown (10YR 7/3) loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, nonsticky and slightly plastic; few very fine roots; common very fine and fine tubular pores; disseminated lime; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk3—46 to 69 inches; very pale brown (10YR 8/3) loam, yellowish brown (10YR 5/4) moist; massive; hard, firm, nonsticky and slightly plastic; few very fine roots; many very fine and fine tubular pores; disseminated lime; strongly effervescent; moderately alkaline.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June to October in areas not irrigated and is moist in some or all parts the rest of the year. Clay content ranges from 20 to 27 percent in the 10- to 40-inch part of the profile. The profile is effervescent throughout.

The A horizon has dry color of 10YR 7/3, 6/2, or 6/3 and moist color of 10YR 3/2, 3/3, 4/2, or 4/3.

The Bk horizon has dry color of 10YR 8/2, 8/3, 7/2, 7/3, 7/4, 6/2, 6/3, or 6/4 and moist color of 10YR 5/3, 4/3, or 5/4. It is loam, very fine sandy loam, or fine sandy loam and is 15 to 27 percent clay.

Gridley Series

The Gridley series consists of moderately deep, moderately well drained soils on terraces and basin rims. These soils formed in alluvium derived from mixed sources. Slope is 0 to 1 percent.

Soils of the Gridley series are fine, montmorillonitic, thermic Typic Argixerolls.

Typical pedon of Gridley clay loam, 0 to 1 percent slopes (fig. 8), 950 feet south and 250 feet east of the northeast corner of sec. 4, T. 15 N., R. 3 E. (not sectionized), in the New Helvetia Land Grant, Sutter quadrangle.

Ap—0 to 9 inches; brown (10YR 5/3) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium angular blocky structure; very hard, friable, sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; neutral; clear smooth boundary.

A—9 to 19 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; very hard, friable, sticky and plastic; few very fine roots; common very fine tubular pores; mildly alkaline; gradual wavy boundary.

Bt1—19 to 28 inches; brown (10YR 5/3) clay, dark yellowish brown (10YR 3/4) moist; moderate coarse subangular blocky structure; extremely hard, firm, very sticky and very plastic; few very fine roots; common very fine and fine tubular pores; few thin clay films on peds and in pores; mildly alkaline; gradual wavy boundary.

Bt2—28 to 37 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 3/4) moist; moderate coarse subangular blocky structure; extremely hard, firm, very sticky and very plastic; few very fine roots; common very fine and fine tubular pores; few thin clay films and common pressure faces on peds; mildly alkaline; clear wavy boundary.

2Cr—37 to 62 inches; very pale brown (10YR 7/4) siltstone, yellowish brown (10YR 5/4) moist; common fine strong brown (7.5YR 4/6) mottles lining pores; massive; extremely hard and firm; few very fine tubular pores; common moderately thick clay films on fracture faces; mildly alkaline.

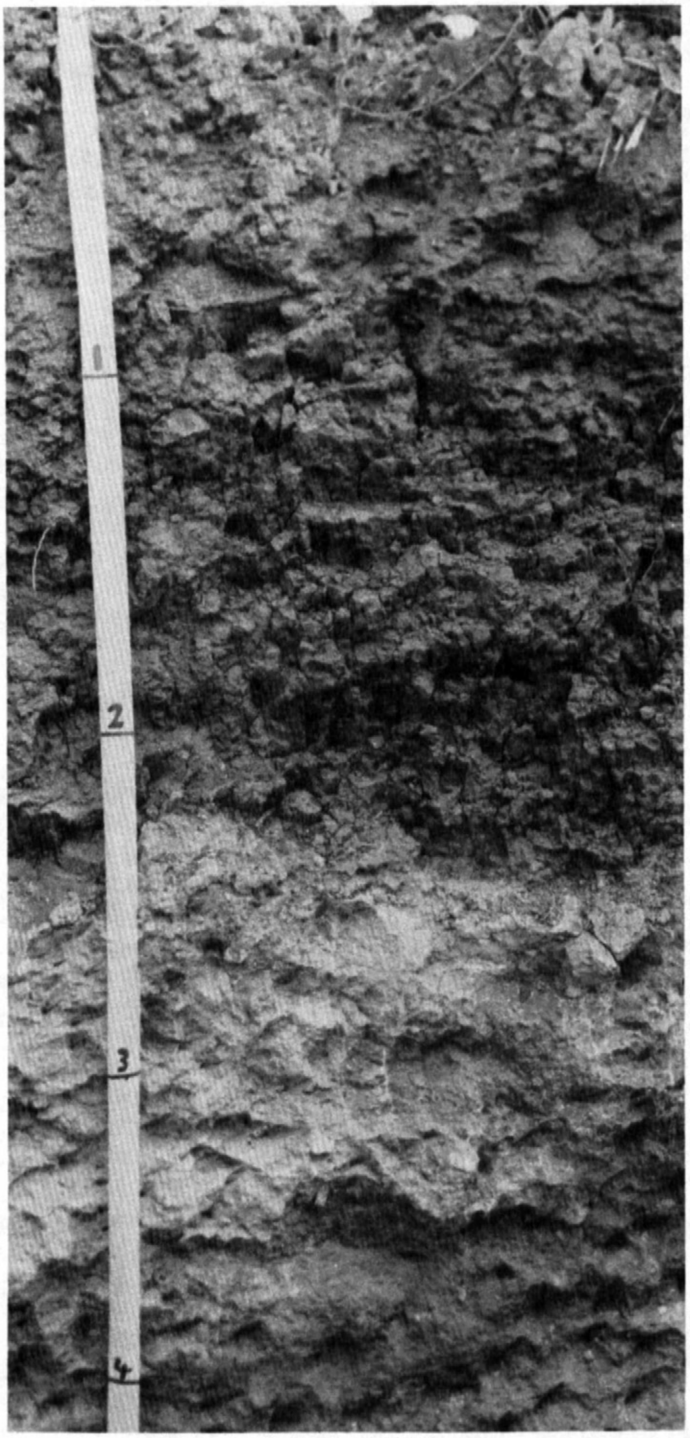

Figure 8.—Profile of Gridley clay loam, 0 to 1 percent slopes, showing an undulating siltstone layer at a depth of 2 to 4 feet.

Depth to paralithic contact ranges from 20 to 40 inches. The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June through October in areas not irrigated and is moist in some or all parts from November through May. Reaction is neutral to moderately alkaline.

The A horizon has dry color of 10YR 5/3 or 5/2 or 7.5YR 5/2 and moist color of 10YR 3/2 or 3/3 or 7.5YR 3/2.

The Bt horizon has dry color of 10YR 6/3, 5/3, 6/4, or 5/4 or 7.4YR 6/4 and moist color of 10YR 3/2, 3/3, 3/4, 4/3, 4/4, or 5/4 or 7/5YR 3/2, 3/3, 4/4, or 4/6. It is clay loam, clay, or silty clay that is 35 to 55 percent clay. It has 5 to 10 percent (absolute) more clay than the A horizon.

Some pedons have a calcareous C horizon above the 2Cr horizon.

Holillipah Series

The Holillipah series consists of very deep, somewhat excessively drained soils on flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Holillipah series are sandy, mixed, thermic Typic Xerofluvents.

Typical pedon of Holillipah loamy sand, channeled, 0 to 2 percent slopes, 2,100 feet north and 3,000 feet east of the intersection of O'Banion Road and Garden Highway in the New Helvetia Land Grant, T. 14 N., R. 3 E. (not sectionized), Olivehurst quadrangle.

A—0 to 8 inches, pale brown (10YR 6/3) loamy sand, brown (10YR 4/3) moist; weak coarse granular structure; soft, loose, nonsticky and nonplastic; many very fine and fine interstitial pores; slightly acid; clear smooth boundary.

Cl—8 to 32 inches; white (10YR 8/1) sand, light gray (10YR 7/1) moist; massive; loose, nonsticky and nonplastic; many very fine and fine and common medium roots; many very fine and fine interstitial pores; neutral; abrupt wavy boundary.

C2—32 to 35 inches; light yellowish brown (10YR 6/4) loamy sand, dark yellowish brown (10YR 4/4) moist; common medium distinct strong brown (7.5YR 4/6) mottles; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine interstitial pores; neutral; abrupt wavy boundary.

C3—35 to 47 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; many medium distinct brown (7.5YR 5/4) mottles; massive; slightly hard, friable, nonsticky and nonplastic; common very fine tubular pores; neutral; gradual irregular boundary.

C4—47 to 61 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine tubular pores; neutral.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from May through October in areas not irrigated and is moist in some or all parts from November through April. The soil is stratified with thick layers of sand, loamy fine sand, loamy sand, fine sandy loam, sandy loam, and silt loam. The particle-size control section is loamy sand or coarser in texture. Organic carbon content decreases irregularly with depth. The profile is slightly acid to neutral.

The A horizon has dry color of 10YR 6/3 or 6/2 and moist color of 10YR 4/3, 4/2, or 3/3. Texture is loamy sand or sandy loam.

The C horizon has dry color of 10YR 8/1, 7/2, 7/3, 6/3, 6/4, or 5/3 and moist color of 10YR 7/1, 7/2, 5/2, 5/3, 4/2, 4/3, 4/4, or 3/3.

Jacktone Series

The Jacktone series consists of moderately deep, somewhat poorly drained soils on basin rims and in basins. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Jacktone series are fine, montmorillonitic, thermic Typic Pelloxererts.

Typical pedon of Jacktone clay, 0 to 2 percent slopes, 100 feet north of Sutter-Sacramento county line, 2,500 feet south and 1,400 feet west of the northeast corner of sec. 10, T. 10 N., R. 4 E., Taylor Monument quadrangle.

Ap—0 to 6 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; common medium prominent strong brown (7.5YR 5/6) mottles; massive; extremely hard, very firm, sticky and plastic; many very fine roots; common very fine tubular pores; neutral; abrupt smooth boundary.

A—6 to 25 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; massive extremely hard, very firm, sticky and plastic; common very fine roots; few very fine tubular pores; common intersecting slickensides; neutral; clear wavy boundary.

ACk—25 to 28 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; massive; extremely hard, very firm, sticky and plastic; common intersecting slickensides; common fine black concretions; few fine rounded soft masses of lime; strongly effervescent; moderately alkaline, clear wavy boundary.

Ck—28 to 35 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, firm, sticky and plastic; few fine tubular and common very fine interstitial pores; common fine black concretions; disseminated lime; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ckqm—35 to 39 inches; indurated silica- and lime-cemented laminar cap 1 to 2 millimeters thick over a brown (10YR 5/3) strongly cemented duripan, dark brown (10YR 4/3) moist; massive; few very fine tubular and interstitial pores; common fine black concretions; common fine seams of lime; strongly effervescent; moderately alkaline; clear wavy boundary.

Cq—39 to 62 inches; pale brown (10YR 6/3) weakly silica cemented duripan, brown (10YR 4/3) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; common very fine tubular pores; duripan breaks to loam when rubbed; moderately alkaline.

Depth to the duripan ranges from 20 to 40 inches. Cracks 1 to 2 centimeters wide extend to a depth of 20 inches or more and are open from June to October in areas not irrigated and are closed the rest of the year. The mean annual soil temperature is 62 to 65 degrees F. The profile is neutral to moderately alkaline. Most pedons are calcareous below a depth of 15 inches.

The A horizon has dry color of 10YR 5/1, 4/1, or 3/1 and moist color of 10YR 3/1 or 2/1 or N 3/0. Clay content ranges from 40 to 60 percent.

The C horizon has dry color of 10YR 7/2, 6/2, 4/2, 6/3, 5/3, or 6/4 and moist color of 10YR 4/2, 4/3, 4/4, or 3/2 or 2.5Y 5/2. Texture is clay loam or clay that is 35 to 60 percent clay.

Liveoak Series

The Liveoak series consists of very deep, well drained soils on low terraces. These soils formed in alluvium derived from mixed sources. Slope is 0 to 1 percent.

Soils of the Liveoak series are fine-loamy, mixed, thermic Typic Haploxerolls.

Typical pedon of Liveoak sandy clay loam, 0 to 1 percent slopes, 1,500 feet south and 500 feet west of the intersection of Sheldon Avenue and Archer Avenue, Boga Land Grant, T. 16 N., R. 3 E. (not sectionized), Gridley quadrangle.

Apl—0 to 5 inches; yellowish brown (10YR 5/4) sandy clay loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular pores; slightly acid; abrupt smooth boundary.

Ap2—5 to 13 inches; yellowish brown (10YR 5/4) sandy clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; common very fine tubular pores; slightly acid, clear wavy boundary.

Bt1—13 to 27 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 3/4) moist; weak subangular blocky structure; hard, friable, sticky and slightly plastic; few very fine roots; common very fine and fine tubular pores; many thin clay films on peds and in pores; neutral; gradual wavy boundary.

Bt2—27 to 43 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 3/4) moist; weak coarse subangular blocky structure; hard, friable, sticky and slightly plastic; few very fine roots; common very fine and fine tubular pores; common thin clay films in pores; neutral; gradual wavy boundary.

BC—43 to 53 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 3/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine tubular pores; neutral; clear wavy boundary.

C—53 to 62 inches; brown (7.5YR 5/4) sandy loam, brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; few very fine tubular pores; mildly alkaline.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June through October in areas not irrigated and is moist in some or all parts from November through May.

The A horizon has dry color of 10YR 5/4, 5/3, or 5/2 and moist color of 10YR 3/3 or 3/2 or 7.5YR 3/2. It is slightly acid to mildly alkaline.

The B horizon has dry color of 10YR 6/3, 6/4, or 5/4 or 7.5YR 5/4 or 5/3 and moist color of 10YR 3/3, 4/3, 3/4, or 4/4 or 7.5YR 3/4 or 4/4. Clay content ranges from 20 to 25 percent. The horizon has 1 to 3 percent (absolute) more clay than the A horizon. It is neutral to moderately alkaline.

The C horizon has dry color of 10YR 5/4, 6/4, or 7/4 or 7.5YR 6/4 or 5/4 and moist color of 10YR 4/4 or 3/4 7.5YR 3/4 or 4/4. It is sandy loam or loamy sand. It is mildly alkaline or moderately alkaline.

Liveoak Variant

The Liveoak Variant consists of deep, moderately well drained soils on flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Liveoak Variant are fine-loamy, mixed, thermic Calcixerollic Xerochrepts.

Typical pedon of a Liveoak Variant loam in an area of Liveoak Variant-Galt Variant complex, frequently flooded, 0 to 2 percent slopes, 2,800 feet east and 320 feet south of the northwest corner of sec. 32, T. 17 N., R. 1 E., Sanborn Slough quadrangle.

A—0 to 6 inches; light brownish gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many medium and fine roots; many very fine and fine tubular pores; disseminated lime; 11 percent calcium carbonate equivalent; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw1—6 to 16 inches; pale brown (10YR 6/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; disseminated lime; violently effervescent; 21 percent calcium carbonate equivalent; moderately alkaline; clear wavy boundary.

Bw2—16 to 30 inches; pale brown (10YR 6/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine tubular pores; disseminated lime; 26 percent calcium carbonate equivalent; many coarse and very coarse rounded siliceous and calcareous concretions; violently effervescent; moderately alkaline; clear irregular boundary.

Bkq—30 to 39 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; massive; soft, friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine tubular poreds disseminated lime; 29 percent calcium carbonate equivalent; many medium rounded siliceous and calcareous concretions; violently effervescent; moderately alkaline; clear smooth boundary.

Bk—39 to 54 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; massive; soft, friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; lime is disseminated and in many fine seams; 27 percent calcium carbonate equivalent; violently effervescent, moderately alkaline; abrupt smooth boundary.

Bkqm—54 to 63 inches; brown (10YR 5/3) duripan, dark brown (10YR 3/3) moist; massive; extremely hard; continuous and indurated with silica and lime; violently effervescent; disseminated lime; abrupt smooth boundary.

2C—63 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; loose, nonsticky and nonplastic; neutral.

Depth to the duripan ranges from 40 to 60 inches. The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June to October and is moist in some or all parts from November to May. Reaction is neutral to moderately alkaline. Clay content in the 10- to 40-inch control section ranges from 18 to 25 percent.

The A horizon has dry color of 10YR 6/2, 7/2, or 6/3 and moist color of 10YR 3/2, 4/2, 3/3, or 4/3.

The B horizon has dry color of 10YR 6/2, 7/3, 6/3, 6/4, or 5/3 and moist color of 10YR 3/2, 3/3, or 4/3. Bicarbonate content ranges from 20 to 30 percent.

Marcum Series

The Marcum series consists of deep and very deep, moderately well drained soils on low terraces and basin rims. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Marcum series are fine, montmorillonitic, thermic Typic Argixerolls.

Typical pedon of Marcum clay loam, siltstone substratum, 0 to 1 percent slopes, 150 feet south and 120 feet west of the northeast corner of sec. 4, T. 13 N., R. 3 E., Gilsizer Slough quadrangle.

Ap—0 to 6 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; few fine tubular and interstitial pores; neutral; clear smooth boundary.

A—6 to 16 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common very fine and few roots; common very fine tubular pores; mildly alkaline; gradual wavy boundary.

Bt1—16 to 28 inches; dark yellowish brown (10YR 4/4) clay loam, dark yellowish brown (10YR 3/4) moist; weak medium and coarse subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine and fine roots; few very fine tubular pores; few thin pressure faces on peds; few fine manganese concretions; moderately alkaline; clear wavy boundary.

Bt2— 28 to 40 inches; strong brown (7.5YR 5/6) clay, strong brown (7.5YR 4/6) moist; weak fine and medium prismatic structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; many thin clay films and pressure faces on peds; few very fine and fine manganese concretions; moderately alkaline; gradual wavy boundary.

Ck—40 to 43 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; few very fine manganese concretions; disseminated lime; slightly effervescent; moderately alkaline; abrupt wavy boundary.

2Cr—43 to 62 inches; very pale brown (10YR 7/4) siltstone, light yellowish brown (10YR 6/4) moist; many black (10YR 2/1) manganese stains on fracture faces and in pores; massive; very hard and very firm; many very fine and few fine and coarse tubular pores; lime in seams and as laminar cap that is 0.5 centimeter thick and is discontinuous within the pedon; slightly effervescent; moderately alkaline.

Depth to paralithic contact is 40 to 80 inches. The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June through October in areas not irrigated and is moist in some or all parts from November through May. Reaction is neutral to moderately alkaline.

The A horizon has dry color of 10YR 5/2, 5/3, or 4/3 or 7.5YR 5/2 and moist color of 10YR 3/2 or 3/3 or 7.5YR 3/2.

The Bt horizon has dry color of 10YR 4/4, 5/3, 5/4 6/3, 6/4, or 7/4 or 7.5YR 6/4 or 5/6 and moist color of 10YR 3/4, 4/3, 4/4, or 5/4 or 7.5YR 3/2, 3/3, 4/4, or 4/6. It is clay loam, silty clay loam, clay, or silty clay that is 30 to 60 percent clay and has a weighted average clay content of more than 35 percent.

The Ck horizon has dry color of 10YR 5/4 or 6/4 and moist color of 10YR 4/3, 4/4, or 5/4.

Nueva Series

The Nueva series consists of very deep, somewhat poorly well drained soils on flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 1 percent.

Soils of the Nueva series are fine-loamy, mixed, thermic Fluventic Haploxerolls.

Typical pedon of Nueva loam, 0 to 1 percent slopes (fig. 9), 1,400 feet east and 1,350 feet north of the southwest corner of sec. 36, T. 16 N., R. 1 W., Meridian quadrangle.

Ap—0 to 7 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine interstitial pores; neutral; clear smooth boundary.

A—7 to 17 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; strong coarse granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine interstitial pores and few fine tubular pores; neutral; clear wavy boundary.

C1—17 to 26 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots; common very fine interstitial pores and few fine tubular pores; mildly alkaline; clear smooth boundary.

C2—26 to 42 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; many fine distinct yellowish brown (10YR 5/8) mottles; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine and fine tubular pores; mildly alkaline; abrupt smooth boundary.

2Ab—42 to 61 inches; dark grayish brown (10YR 4/2) clay loam, black (10YR 2/1) moist; massive; hard, very friable, sticky and plastic; common very fine roots; many very fine and fine tubular pores; moderately alkaline.

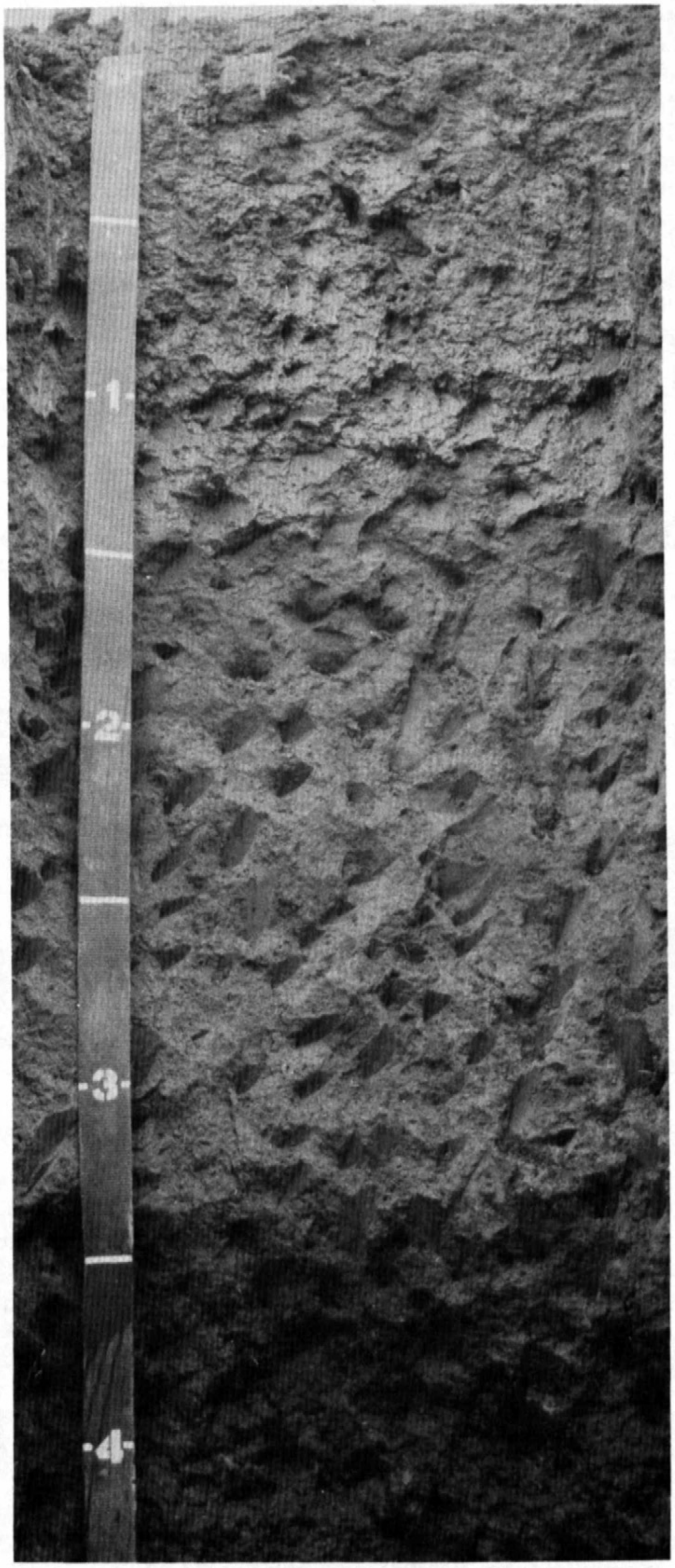

Figure 9.—Profile of Nueva loam, 0 to 1 percent slopes.

The mean annual soil temperature ranges from 62 to 65 degrees F. The soil moisture control section is dry in all parts from June through October in areas not irrigated and is moist in some or all parts from November through May.

The 10- to 40-inch particle-size control section is stratified layers of loam, silt loam, fine sandy loam, and sandy loam. Clay content ranges from 15 to 27 percent but averages more than 18 percent; content of sand that is fine or coarser is more than 15 percent. Content of organic matter decreases irregularly with depth.

The A horizon has dry color of 10YR 5/3, 5/2, 5/1, or 4/1 and moist color of 10YR 3/3, 3/2, 3/1, or 2/1. It is neutral or mildly alkaline.

The C horizon has dry color of 10YR 6/3 or 5/3 and moist color of 10YR 4/3 or 3/3. It is mildly alkaline or moderately alkaline.

The Ab horizon has dry color of 10YR 4/2, 5/2, or 4/1 and moist color of 10YR 3/1, 2/1, or 3/2. It is clay loam or silty clay loam. Some pedons do not have an Ab horizon.

Ocraig Series

The Ocraig series consists of very shallow, somewhat excessively drained soils on mountains. These soils formed in residuum derived from extrusive igneous rock. Slope is 30 to 75 percent.

Soils of the Ocraig series are loamy, mixed, nonacid, thermic Lithic Xerorthents.

Typical pedon of Ocraig gravelly coarse sandy loam, 50 to 75 percent slopes, 700 feet east of the northwest corner of sec. 36, T. 16 N., R. 1 E., Sutter Buttes quadrangle.

A—0 to 2 inches; brown (10YR 5/3) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; many very fine interstitial pores and common very fine tubular pores; 20 percent pebbles; neutral; clear smooth boundary.

C—2 to 8 inches; pale brown (10YR 6/3) gravelly coarse sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common very fine tubular pores; 20 percent pebbles; neutral; clear smooth boundary.

R—8 inches; light gray (10YR 7/1) hard fractured coarse grained andesite.

Depth to lithic contact ranges from 4 to 10 inches. The mean annual soil temperature is 60 to 64 degrees F. The soil moisture control section is dry from April 15 to October 31 and is moist from November 1 to April 15. The profile is 15 to 35 percent fragments, of which 0 to 20 percent is stones, 0 to 5 percent is cobbles, and 15 to 30 percent is gravel. Clay content ranges from 5 to 15 percent. The profile is gravelly coarse sandy loam or very stony coarse sandy loam. Content of very coarse sand and coarse sand is more than 20 percent.

The C horizon has dry color of 10YR 6/3 or 5/4 and moist color of 10YR 3/3 or 4/4.

Olashes Series

The Olashes series consists of very deep, well drained soils on alluvial fans. These soils formed in alluvium derived from mixed sources. Slope is 0 to 5 percent.

Soils of the Olashes series are fine-loamy, mixed, thermic Mollic Haploxeralfs.

Typical pedon of Olashes sandy loam, 0 to 2 percent slopes, 1,100 feet north and 1,400 feet west of the southeast corner of sec. 18, T. 16 N., R. 1 E., Meridian quadrangle.

Ap—0 to 4 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine interstitial pores; slightly acid; clear smooth boundary.

Btl—4 to 14 inches; pale brown (10YR 6/3) sandy clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; hard, very friable, sticky and plastic; few very fine roots; many very fine tubular pores; 2 percent pebbles; many thin clay films in pores and bridging mineral grains; slightly acid; clear wavy boundary.

Bt2—14 to 31 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, very friable, sticky and plastic; many very fine tubular pores; 5 percent pebbles; many moderately thick clay films in pores and common thin clay films on peds; neutral; clear wavy boundary.

Bt3—31 to 52 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine tubular pores; 10 percent pebbles; many moderately thick clay films in pores and bridging mineral grains; mildly alkaline; clear smooth boundary.

2C—52 to 62 inches; yellowish brown (10YR 5/4) sand, brown (10YR 4/3) moist; single grain; loose, nonsticky and nonplastic; many very fine irregular pores; 14 percent pebbles; mildly alkaline.

Mean annual soil temperature ranges from 62 to 65 degrees F. The soil moisture control section is dry in all parts from June through October unless irrigated and is moist in some or all parts from November through May. Gravel content ranges from 0 to 15 percent.

The A horizon has dry color of 10YR 6/3, 5/2, or 6/2 and moist color of 10YR 3/2, 3/3, or 2/2. It is slightly acid or neutral. Organic matter content in the upper 4 inches is more than 1 percent.

The Bt horizon has dry color of 10YR 6/3, 6/4, 5/2, or 5/3 and moist color of 10YR 4/3, 4/4, 3/3, 3/4, or 2/2 or 7.5YR 4/2 or 3/2. It is 20 to 35 percent clay and has a clay increase of 4 to 10 percent (absolute) as compared to the A horizon. Reaction is neutral or mildly alkaline.

Oswald Series

The Oswald series consists of moderately deep, poorly drained soils in basins and on basin rims. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Oswald series are fine, montmorillonitic, thermic Aquic Chromoxererts.

Typical pedon of Oswald clay, 0 to 2 percent slopes, 2,510 feet west and 1,700 feet north from the southeast corner of sec. 11, T. 14 N., R. 2 E., Gilsizer Slough quadrangle.

Ap—0 to 7 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; few fine distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) mottles dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) moist; moderate medium granular structure; very hard, firm, very sticky and plastic; common very fine and fine roots; few very fine tubular pores and common very fine and fine interstitial pores; neutral; gradual wavy boundary.

A—7 to 15 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; common fine distinct yellowish brown (10YR 5/6) and brownish yellow (10YR 6/6) mottles, dark yellowish brown (10YR 4/6) and yellowish brown (10YR 5/6) moist; moderate medium prismatic structure parting to strong medium angular blocky; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; few fine rounded manganese concretions; many intersection slickensides at about 20 to 45 degree angles; moderately alkaline; gradual wavy boundary.

C—15 to 33 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; few fine distinct yellowish brown (10YR 5/6) mottles, dark yellowish brown (10YR 4/6) moist; moderate medium prismatic structure parting to strong medium angular blocky; very hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; few fine rounded manganese concretions; many intersecting slickensides at about 20 to 45 degree angles; few soft masses of lime and disseminated lime; slightly effervescent in the lower 4 inches; moderately alkaline; abrupt wavy boundary.

2Cr—33 to 43 inches; light gray (10YR 7/2) siltstone, pale brown (10YR 6/3) moist; many fine distinct yellowish brown (10YR 5/4, 5/6, 5/8) and brownish yellow (10YR 6/6) mottles, dark yellowish brown and yellowish brown (10YR 4/4, 4/6, 5/6) moist; few fine manganese stains, black (10YR 2/1); massive; very hard, very firm, common very fine and fine tubular and interstitial pores; few thin clay films on fracture faces; common fine seams of lime; strongly effervescent; moderately alkaline.

Depth to paralithic contact ranges from 20 to 40 inches. The profile is 40 to 60 percent clay. Cracks 1 to 2 inches wide extend to a depth of 20 to 30 inches and are open from June to October in areas not irrigated and are closed the rest of the year. The mean annual soil temperature is 62 to 65 degrees F. Reaction is neutral to moderately alkaline.

The A horizon has dry color of 10YR 5/2 or 5/3 and moist color of 10YR 3/2 or 3/3. It has few or common mottles of 10YR 5/6, 6/6, or 4/6 when moist or dry.

The C horizon has dry color of 10YR 5/3 or 6/3 and moist color of 10YR 4/3, 3/3, or 4/2. It is clay or silty clay.

Palls Series

The Palls series consists of moderately deep, well drained soils on hills. These soils formed in residuum derived from andesite and andesitic lahar. Slope is 9 to 60 percent.

Soils of the Palls series are coarse-loamy, mixed, thermic Mollic Haploxeralfs.

Typical pedon of Palls stony sandy loam in an area of Palls-Stohlman stony sandy loams, 9 to 30 percent slopes, 750 feet south and 2,900 feet east of the northwest corner of sec. 32, T. 16 N., R. 1 E., Meridian quadrangle.

A1—0 to 2 inches; brown (10YR 5/3) stony sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many very fine tubular pores; 2 percent boulders, 3 percent stones, 2 percent cobbles, and 10 percent pebbles; medium acid; abrupt smooth boundary.

A2—2 to 8 inches; light brownish gray (10YR 6/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; massive; extremely hard, very friable, nonsticky and nonplastic; many very fine roots; many very fine tubular pores; 2 percent boulders, 3 percent stones, 2 percent cobbles, and 10 percent pebbles; medium acid; clear wavy boundary.

Bt1—8 to 21 inches; light brownish gray (10YR 6/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine and fine tubular pores; 2 percent stones, 5 percent cobbles, and 10 percent pebbles; common thin clay films in pores; neutral; clear wavy boundary.

Bt2—21 to 29 inches; light brownish gray (10YR 6/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine tubular pores; 2 percent stones, 5 percent cobbles, and 10 percent pebbles; many thin clay films on peds and in pores; neutral; abrupt smooth boundary.

Bt3—29 to 31 inches; pale brown (10YR 6/3) gravelly sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; common very fine tubular pores; 2 percent stones, 5 percent cobbles, and 10 percent pebbles; common moderately thick clay films on peds and in pores; slightly acid; abrupt smooth boundary.

R—31 inches; yellowish brown (10YR 5/4) hard andesitic lahar.

Depth to lithic contact ranges from 20 to 40 inches. The mean annual soil temperature ranges from 62 to 64 degrees F. The soil moisture control section is dry in all parts from April 15 to October 31 and is moist in some or all parts from November 1 to April 15. The profile is 15 to 35 percent rock fragments.

The A horizon has dry color of 10YR 6/2, 6/3, 5/2, or 5/3 and moist color of 3/2 or 3/3. The profile is 0 to 5 percent boulders, 5 to 15 percent stones and cobbles, and 10 to 25 percent gravel. Organic matter content in the upper 4 inches is more than 1 percent.

The Bt horizon has dry color of 10YR 6/2, 6/3, or 5/4 and moist color of 4/2, 4/3, 3/2, 3/3, or 3/4. Clay content ranges from 10 to 27 percent. Weighted average clay content is 10 to 18 percent. The clay content (absolute) is 3 to 8 percent more than that in the A horizon. The horizon is 0 to 10 percent stones, 5 to 10 percent cobbles, and 10 to 25 percent pebbles.

Some pedons do not have a Bt3 horizon.

San Joaquin Series

The San Joaquin series consists of moderately deep, well drained soils on terraces. These soils formed in alluvium derived from mixed sources, mainly granite. Slope is 0 to 2 percent.

Soils of the San Joaquin series are fine, mixed, thermic Abruptic Durixeralfs.

Typical pedon of San Joaquin sandy loam, 0 to 2 percent slopes (fig. 10), 600 feet west and 800 feet south of the northeast corner of sec. 36, T. 12 N., R. 4 E., Pleasent Grove quadrangle.

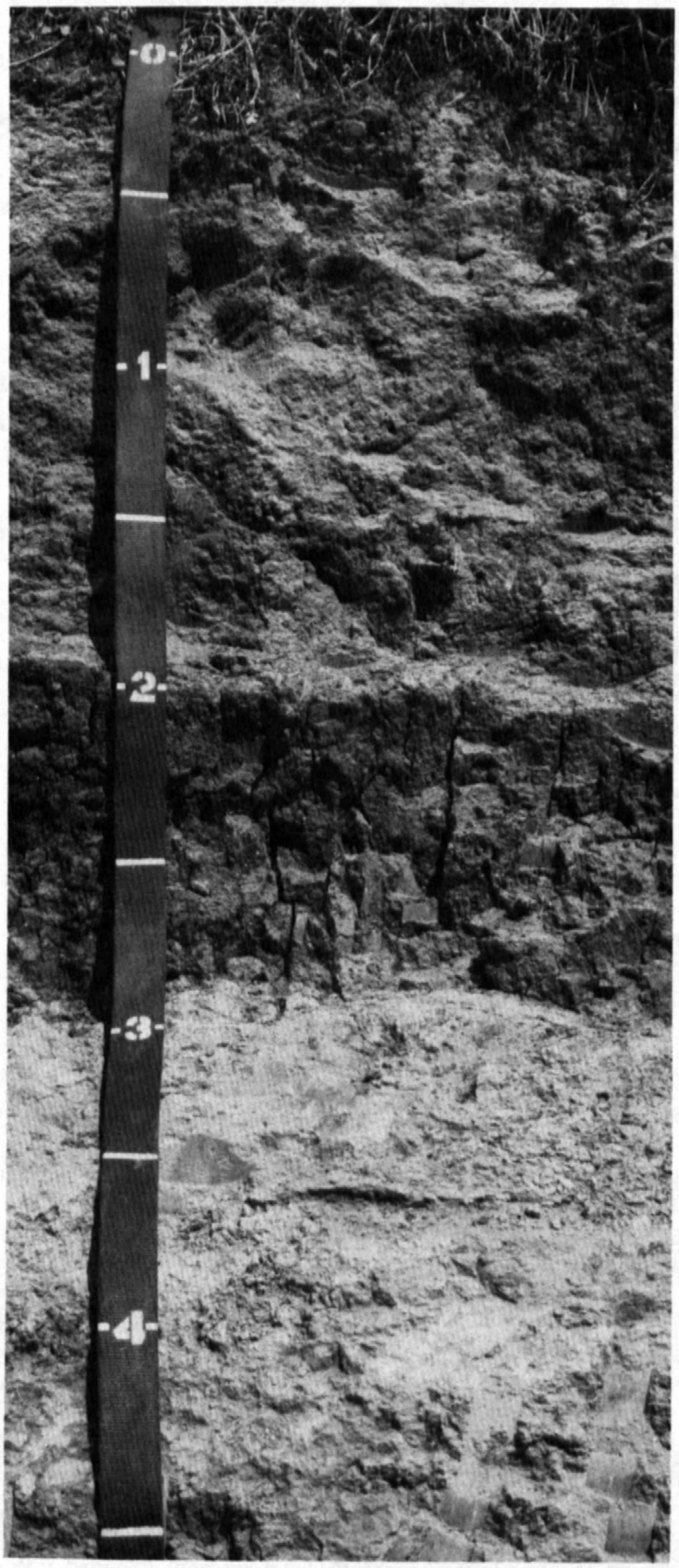

Figure 10.—Profile of San Joaquin sandy loam, 0 to 2 percent slopes.

Ap—0 to 5 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) moist; moderate medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; medium acid; clear smooth boundary.

A—5 to 11 inches; brown (7.5YR 5/4) sandy loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common very fine tubular pores and few fine tubular and interstitial pores; few very fine manganese concretions; medium acid; clear smooth boundary.

Btl—11 to 16 inches; yellowish red (5YR 5/6) sandy loam, yellowish red 5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores and few fine tubular and interstitial pores; common thin clay films lining pores; few very fine manganese concretions; neutral; abrupt smooth boundary.

Bt2—16 to 22 inches; yellowish red (5YR 4/6) clay, yellowish red (5YR 4/6) moist; massive; very hard, firm, very sticky and very plastic; common very fine tubular pores; many intersecting slickensides; few very fine manganese concretions; mildly alkaline; clear smooth boundary.

Bt3—22 to 27 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; massive; very hard, firm, very sticky and very plastic; many intersecting slickensides; mildly alkaline; abrupt smooth boundary.

Cqm—27 to 31 inches; strong brown (7.5YR 5/6) duripan, dark brown (7.5YR 4/4) moist; massive; extremely hard, very firm, nonsticky and nonplastic; indurated by a laminar silica cap 1 centimeter thick; common manganese and iron stains in seams below moderately alkaline; abrupt smooth boundary.

Cq—31 to 39 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist; massive; hard, firm, slightly sticky and slightly plastic; moderately alkaline; clear smooth boundary.

C—39 to 60 inches; yellowish red (5YR 4/6) coarse sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable, slightly sticky and nonplastic; mildly alkaline.

Depth to the duripan is 20 to 40 inches. The mean annual soil temperature is about 62 to 64 degrees F. The soil moisture control section usually is dry all of the time from about June to November in areas not irrigated and is moist in some or all parts all the rest of the year.

The A horizon has dry color of 7.5YR 6/4, 6/6, or 5/4 or 5YR 5/6 and moist color of 7.5YR 4/4, 5/6, or 3/4 or 5YR 5/6 or 3/4. Reaction is medium acid or slightly acid. Clay content ranges from 10 to 20 percent.

The Bt horizon has dry color of 7.5YR 4/6 or 5/4 or 5YR 4/6 or 5/6 and moist color of 7.5YR 4/4 or 5YR 4/4, 4/6, or 3/3. Reaction is slightly acid to mildly alkaline. Weighted average clay content ranges from 35 to 45 percent. There is a 15 percent (absolute) clay increase in the upper 1 inch of the horizon.

The duripan is stained with coatings of iron and manganese and usually is smooth and more indurated at its upper boundary. It becomes less consolidated with depth but has thin indurated strata.

Shanghai Series

The Shanghai series consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Shanghai series are fine-silty, mixed, nonacid, thermic Aquic Xerofluvents.

Typical pedon of Shanghai silt loam, frequently flooded, 0 to 2 percent slopes (fig. 11), 2,000 feet north and 900 feet east of the intersection of Rednall Road and the western levee of the Feather River, in T. 15 N., R. 3 E. (not sectionized) of the New Helvetia Land Grant, Yuba City quadrangle.

Ap—0 to 11 inches; very pale brown (10YR 7/4) silt loam, brown (10YR 4/3) moist; common medium distinct yellowish brown (10YR 5/6) mottles; yellowish brown (10YR 5/8) moist; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine roots; common very fine tubular pores; neutral; clear smooth boundary.

A—11 to 21 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 4/3) moist; common large distinct strong brown (7.5YR 5/6) mottles; dark yellowish brown (10YR 4/6) moist; massive; slightly hard, friable, slightly sticky and plastic; common very fine roots; common very fine tubular pores; neutral; gradual wavy boundary.

C1—21 to 27 inches; pale brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) moist; many medium prominent yellowish brown (10YR 5/8) and many large prominent strong brown (7.5YR 4/6) mottles, dark yellowish brown (10YR 3/6) and dark reddish brown (2.5YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine tubular pores; neutral; gradual wavy boundary.

C2—27 to 36 inches; pale brown (10YR 6/3) silt loam, dark yellowish brown (10YR 4/4) moist; many medium prominent yellowish brown (10YR 5/8) mottles and many large prominent strong brown (7.5YR 4/6) mottles, dark yellowish brown (10YR 3/6) and dark reddish brown (2.5YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common

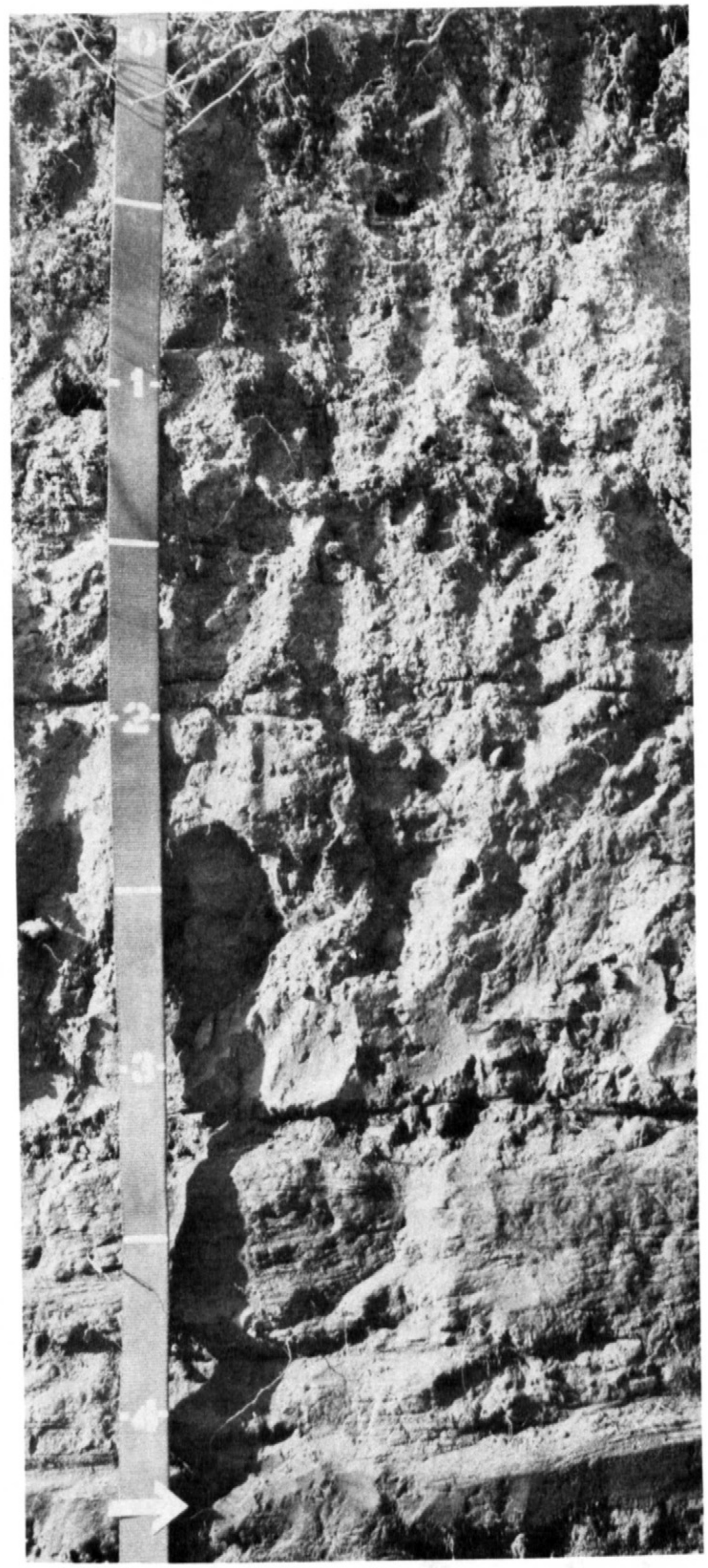

Figure 11.—Profile of Shanghai silt loam, frequently flooded, 0 to 2 percent slopes. Arrow points to silt layer underlain by a layer of loamy sand.

very fine tubular pores; neutral; gradual wavy boundary.

C3—36 to 54 inches; very pale brown (10YR 7/3) silt loam, dark yellowish brown (10YR 4/4) moist; common medium distinct strong brown (7.5YR 4/6) mottles, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; neutral; gradual wavy boundary.

C4—54 to 67 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 3/3) moist; many medium distinct yellowish red (5YR 5/8) mottles; massive; soft, friable, slightly sticky and slightly plastic; few very fine roots; common very fine pores; neutral.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June through October in areas not irrigated and is moist in some or all parts from November through May.

The 10- to 40-inch control section is strata of silt loam to fine sandy loam and silty clay loam, but it is dominantly silt loam that is less than 15 percent sand that is coarser than very fine sand. Clay content ranges from 20 to 35 percent. Content of organic matter decreases irregularly with depth. Reaction is neutral to moderately alkaline.

The A horizon has dry color of 10YR 7/4, 6/4, 5/4, 7/3, or 6/3 or 2.5Y 6/2 or 7/2 and moist color of 10YR 4/4 or 4/3 or 2.5Y 4/2, 3/2, or 3/3; mottled colors are 10YR 4/6, 5/6, or 5/8, 7.5YR 5/6 or 7/6, or 5YR 6/8 when dry or moist. It is silty clay loam, silt loam, or fine sandy loam.

The C horizon has dry color of 10YR 7/4, 6/4, 8/3, 7/3, or 6/3 or 2.5Y 6/2 or 7/2 and moist color of 10YR 6/3, 5/3, 3/3, 5/4, or 4/4 or 2.5Y 5/2 or 4/2. Some pedons have a clay layer at a depth of 40 to 60 inches that has dry color of 10YR 4/1 or 2/1.

Shanghai Variant

The Shanghai Variant consists of very deep, somewhat poorly drained soils on flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 1 percent.

Soils of the Shanghai Variant are sandy over loamy, mixed, nonacid, thermic Aquic Xerofluvents.

Typical pedon of Shanghai Variant loamy sand, 0 to 1 percent slopes, 800 feet east and 1,200 feet north of the southwest corner of sec. 17, T. 15 N., R. 1 E., Meridian quadrangle.

Ap—0 to 10 inches; pale brown (10YR 6/3) loamy sand, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable,, nonsticky and nonplastic; few very fine and fine roots; common very fine interstitial pores; neutral; abrupt wavy boundary.

A2—10 to 18 inches; pale brown (10YR 6/3) loamy sand, dark brown (10YR 3/3) moist; single grain; loose, nonsticky and nonplastic; common fine roots; few very fine interstitial pores; neutral; abrupt smooth boundary.

C—18 to 29 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; common fine distinct dark yellowish brown (10YR 4/4) mottles at a depth of 26 inches; massive; soft, very friable, slightly sticky and slightly plastic; common fine roots; few very fine interstitial and tubular pores; neutral; clear wavy boundary.

2A1b—29 to 52 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate coarse subangular blocky structure; slightly hard, firm, sticky and plastic; common fine and medium roots; common fine and few medium tubular pores; moderately alkaline; abrupt wavy boundary.

2A2b—52 to 62 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; few fine roots; few fine tubular pores; moderately alkaline.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June to October in areas not irrigated and is moist in some or all parts from November to May. The upper part of the 10- to 40-inch control section ranges from 4 to 10 percent clay. It is loamy sand or loamy fine sand. Clay content in the lower part is 18 to 35 percent. It is stratified loam, silt loam, and silty clay loam. Depth to a buried layer ranges from 15 to 30 inches.

The A horizon has dry color of 10YR 6/3 or 6/2 and moist color of 10YR 4/3, 3/3, or 3/2.

The Ab horizon has dry color of 10YR 5/3, 4/1, 4/2, or 4/3 and moist color of 10YR 3/1, 3/2, or 3/3. Reaction is mildly alkaline or moderately alkaline.

Snelling Series

The Snelling series consists of very deep, well drained soils on stream terraces. These soils formed in alluvium derived dominantly from granitic sources. Slope is 0 to 2 percent.

Soils of the Snelling series are fine-loamy, mixed, thermic Typic Haploxeralfs.

Typical pedon of Snelling loam, 0 to 2 percent slopes, 270 feet south and 2,435 feet west of the northeast corner of sec. 33, T. 13 N., R. 5 E., Sheridan quadrangle.

A—0 to 3 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; weak fine and very fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine tubular pores; slightly acid; clear smooth boundary.

Btl—3 to 11 inches; strong brown (7.5YR 5/6) loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine tubular pores; few thin clay films in pores; slightly acid; clear smooth boundary.

Bt2—11 to 19 inches; strong brown (7.5YR 5/6) loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; hard, friable, sticky and slightly plastic; few fine roots; many fine and medium tubular pores; common thin clay films in pores; slightly acid; clear wavy boundary.

Bt3—19 to 32 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate subangular structure; hard, friable, sticky and slightly plastic; few fine roots; few very fine and medium tubular pores; common thin clay films in pores and on ped faces; neutral; clear wavy boundary.

Bt4—32 to 51 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; very hard, firm, sticky and plastic; common moderately thick clay films in pores and on ped faces; neutral; gradual wavy boundary.

C—51 to 62 inches; yellowish red (5YR 4/6) sandy loam, reddish brown (5YR 4/4) moist; massive; very hard, firm, sticky and plastic; few very fine tubular pores; neutral.

The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry all of the time from late in May until November in areas not irrigated and usually is moist in some or all parts all the rest of the year.

The A horizon has dry color of 10YR 6/3 or 7.5YR 5/3, 6/3, or 5/4 and moist color of 7.5YR 4/3, 3/4, or 4/4 or 10YR 4/3.

The Bt horizon has dry color of 7.5YR 6/4, 5/4, or 5/6 or 5YR 5/4 and moist color of 7.5YR 5/4, 4/4, or 3/4 or 5YR 4/4. Clay content ranges from 20 to 30 percent. This horizon has 5 to 12 percent (absolute) more clay than the A horizon. Reaction is slightly acid to neutral.

Stohlman Series

The Stohlman series consists of shallow, well drained soils on hills. These soils formed in residuum derived from andesite and andesitic lahar. Slope is 9 to 50 percent.

Soils of the Stohlman series are loamy, mixed, thermic Lithic Mollic Haploxeralfs.

Typical pedon of Stohlman stony sandy loam in an area of Palls-Stohlman stony sandy loams, 9 to 30 percent slopes, 450 feet south and 3,100 feet east of the northwest corner of sec. 32, T. 16 N., R. 1 E., Meridian quadrangle.

A1—0 to 1 inches; light brownish gray (10YR 6/2) stony sandy loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; few very fine interstitial pores; 1 percent boulders, 8 percent stones, 2 percent cobbles, and 10 percent pebbles; slightly acid; abrupt smooth boundary.

A2—1 to 7 inches; pale brown (10YR 6/3) stony sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine interstitial pores; 1 percent boulders, 8 percent stones, 2 percent cobbles, and 10 percent pebbles; slightly acid; clear wavy boundary.

Bt1—7 to 15 inches; pale brown (10YR 6/3) gravelly sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores and many very fine interstitial pores; many thin clay films in pores; 5 percent cobbles and 17 percent pebbles; slightly acid; clear smooth boundary.

Bt2—15 to 16 inches; pale brown (10YR 6/3) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores and many very fine interstitial pores; many thin clay films on peds and in pores and many thick clay films as bridges between mineral grains; 5 percent cobbles and 17 percent pebbles; slightly acid; abrupt smooth boundary.

R—16 inches; yellowish brown (10YR 5/6) hard andesitic lahar.

Depth to lithic contact ranges from 10 to 20 inches. The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from April 15 to October 31 and is moist in some or all parts from November 1 to April 15. The profile is 15 to 35 percent rock fragments. It is slightly acid or neutral.

The A horizon has dry color of 10YR 6/2 or 6/3 and moist color of 10YR 3/2 or 3/3. It is 0 to 5 percent boulders, 5 to 15 percent stones and cobbles, and 10 to 25 percent pebbles. Organic matter content in the upper 4 inches is more than 1 percent.

The B2t horizon has dry color of 10YR 6/3 or 6/4 and moist color of 10YR 4/4 or 3/3. Clay content ranges from 10 to 18 percent. The horizon has 3 to 10 percent (absolute) more clay than the A horizon. It is 0 to 5 percent stones, 5 to 10 percent cobbles, and 10 to 25 percent pebbles.

Subaco Series

The Subaco series consists of moderately deep, poorly drained soils in basins and on basin rims. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Subaco series are fine, montmorillonitic, thermic Typic Pelloxererts.

Typical pedon of Subaco clay, 0 to 2 percent slopes (fig. 12), 1,800 feet east and 200 feet south from the northwest corner of sec. 3, T. 13 N., R. 2 E., Gilsizer Slough quadrangle.

Figure 12.—Profile of Subaco clay, 0 to 2 percent slopes.

Ap—0 to 13 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak fine and medium subangular blocky structure; very hard, firm, sticky and plastic; common fine and many very fine roots; common very fine and fine tubular pores; moderately alkaline; clear wavy boundary.

C—13 to 26 inches; gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; few fine distinct strong brown (7.5YR 4/6) mottles; dark brown (7.5YR 3/4) moist; massive; very hard, firm, very sticky and very plastic; few very fine roots in cracks; common fine tubular pores; common slickensides; common fine manganese concretions; moderately alkaline; abrupt smooth boundary.

2Cr—26 to 47 inches; light gray (10YR 7/2) siltstone, brown (10YR 4/3) moist; massive; very hard, extremely firm, nonsticky and nonplastic; few very fine roots in cracks; many very fine tubular pores; lime in a few fine segregated seams and in a discontinuous cap 1 millimeter thick; slightly effervescent; moderately alkaline.

Depth to paralithic contact ranges from 20 to 40 inches. Clay content in the 10- to 40-inch control section ranges from 40 to 60 percent. Cracks 1 to 3 centimeters wide extend to a depth of 25 inches or more or to the Cr horizon, at a depth of 20 to 40 inches; they are open from June to October in areas not irrigated and are closed the rest of the year. The mean annual soil temperature is 62 to 65 degrees F. Reaction is mildly alkaline or moderately alkaline.

The A horizon has dry color of 10YR 5/1 or 4/1 and moist color of 10YR 3/1 or 2/1.

The C horizon has dry color of 10YR 5/1 or 4/1 and moist color of 10YR 3/1 or 2/1. It has common to many slickensides throughout.

Tisdale Series

The Tisdale series consists of moderately deep, well drained soils on low terraces. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Tisdale series are fine-loamy, mixed, thermic Typic Haploxerolls.

Typical pedon of Tisdale clay loam, 0 to 2 percent slopes, 2,000 feet north and 2,500 feet east of the southwest corner of sec. 19, T. 14 N., R. 3 E., Gilsizer Slough quadrangle.

Ap—0 to 7 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine and fine roots; many very fine and fine tubular pores; mildly alkaline; clear smooth boundary.

A—7 to 11 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common very fine and fine roots; many very fine and fine tubular pores; mildly alkaline; clear wavy boundary.

Bt1—11 to 21 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine and medium roots; many very fine and fine and few medium tubular pores; few thin clay films on ped faces; moderately alkaline; clear wavy boundary.

Bt2—21 to 31 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, very sticky and plastic; few very fine roots; many very fine and fine tubular pores; few thin clay films on ped faces and in pores; moderately alkaline; abrupt wavy boundary.

2Cr—31 to 40 inches; very pale brown (10YR 8/3) siltstone, pale brown (10YR 6/3) moist; massive; very hard and extremely firm; common very fine tubular pores; common fine seams of lime; slightly effervescent; moderately alkaline.

Depth to paralithic contact is 20 to 40 inches. The mean annual soil temperature is 62 to 65 degrees F. The soil moisture control section is dry in all parts from June through October in areas not irrigated and is moist in some or all parts from November through May. Clay content ranges from 20 to 35 percent.

The A horizon has dry color of 10YR 5/2 or 5/3 and moist color of 10YR 3/2 or 3/3. Reaction is neutral or mildly alkaline.

The Bt horizon has dry color of 10YR 5/3, 5/4, 6/3, or 6/4 and moist color of 10YR 4/3, 4/4, 3/3, or 3/4. It is loam or clay loam and has 1 to 3 percent (absolute) more clay than the A horizon. Reaction is neutral to moderately alkaline.

Yuvas Series

The Yuvas series consists of moderately deep, moderately well drained soils on terraces and basin rims. These soils formed in alluvium derived from mixed sources. Slope is 0 to 2 percent.

Soils of the Yuvas series are fine, mixed, thermic Abruptic Durixeralfs.

Typical pedon of Yuvas loam, 0 to 2 percent slopes, 200 feet west, 300 feet north of the southeast corner of sec. 15, T. 13 N., R. 3 E., Nicolaus quadrangle.

Ap—0 to 5 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 3/4) moist; few medium prominent reddish yellow (7.5YR 6/8) mottles, strong brown (7.5YR 5/8) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; common fine and many very fine roots; common very fine and fine tubular pores; common fine and medium manganese concretions; medium acid; gradual smooth boundary.

A1—5 to 10 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; few medium prominent reddish yellow (7.5YR 7/8) mottles, red (2.5YR 4/8) moist; weak coarse subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common very fine and fine tubular pores; common fine and medium manganese concretions; medium acid; gradual wavy boundary.

A2—10 to 16 inches; light yellowish brown (10YR 6/4) loam, brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine and fine tubular pores; common fine and medium manganese concretions; mildly alkaline; abrupt irregular boundary.

2Bt—16 to 24 inches; pink (7.5YR 8/4) clay, yellowish red (5YR 4/6) moist; moderate coarse angular blocky structure; very hard, firm, very sticky and very plastic; few very fine tubular pores; common fine manganese concretions and stains; common pressure faces; moderately alkaline; abrupt smooth boundary.

2Ckqm—24 to 38 inches; very pale brown (10YR 7/4) duripan, reddish yellow (7.5YR 6/6) moist; massive; continuously indurated by 1 laminar silica cap 1 millimeter thick; cap of lime; common manganese and iron stains in seams below capping; strongly effervescent; moderately alkaline; abrupt smooth boundary.

3Cr—38 to 60 inches; light gray (10YR 7/2) weakly consolidated siltstone.

Depth to the duripan ranges from 20 to 38 inches. Depth to siltstone ranges from 22 to 40 inches. The soil moisture control section temperature is more than 47 degrees F the entire year. The soil usually is dry in all parts from June through October and is moist in some or all parts from November through May.

The A horizon has dry color of 10YR 6/3 or 6/4 and moist color of 10YR 3/2, 3/3, 4/3, or 3/4 or 7.5YR 4/4. It is slightly acid or neutral. Clay content ranges from 18 to 27 percent.

The Bt horizon has dry color of 7.5YR 8/4, 6/4, or 5/6 and moist color of 7.5YR 4/3 or 4/4 or 5YR 4/6 or 3/3. It is mildly alkaline or moderately alkaline. Clay content ranges from 40 to 60 percent. The transition between the A and 2Bt horizons is abrupt; there is more than 15 percent (absolute) clay in the upper 1 inch of the 2Bt horizon than in the A horizon.

The duripan has dry color of 10YR 7/4, 7/6, or 4/4. It is continuously indurated with a laminar silica cap 1 to 5 millimeters thick and has laminar accumulations of calcium carbonate above it.

Formation of the Soils

Soil is a continually evolving body of mineral and organic matter maintained in the midst of a stream of pedologic, biologic, and hydrologic processes. Because of these complex processes, soils differ in their appearance, composition, productivity, and management requirements.

There are five factors of soil formation—time, climate, organisms, relief, and parent material. Each soil in the survey area is affected by these five factors, but the relative effect of each factor varies from one soil to another and is directly related to landform. In the following paragraphs, the factors of soil formation are related to the four basic landforms in the survey area—flood plains, basins, low alluvial terraces, and uplands.

Flood plains.—The flood plains are along the Sacramento, Feather, and Bear Rivers. These rivers were originally confined within broad natural levees sloping away from the rivers, but in recent historic time they have been restrained by manmade levees. The natural levees were formed by alluvium deposited during flooding, during which the coarser textured material settled out first and typically was deposited near the rivers. As distance from the rivers increased, the material deposited generally was finer in texture. The soils that formed in these natural levee deposits are among the most fertile and productive ones in the survey area.

The alluvium deposited by the frequent flooding of these rivers was derived from various kinds of rock in the North Coast, Trinity, Cascade, and Sierra Nevada Ranges. The age of these deposits is probably less than 3,000 years (*9*). The most recent deposits were laid down by flooding associated with hydraulic mining in watershed areas upstream. This hydraulic mining activity in the foothills of the Sierra Nevada has dumped millions of tons of debris in the Feather, Sacramento, and Bear Rivers, clogging channels and raising the base level of the rivers. Even today, sediment continues to be deposited inside the levees of these rivers during flood stage.

The native vegetation on these flood plains consisted mainly of cottonwoods, willows, shrubs, and grasses. As plants, organic debris, and the soil surface are covered by soil during flooding, a record of past flooding is preserved in the soils and is evidenced by an irregular decrease in organic matter with depth. The Columbia, Shanghai, and Holillipah soils that formed on these flood plains have few morphological features other than a weakly expressed, darker colored surface layer; an irregular decrease in organic matter content with depth; and stratified subsurface material.

Basins.—When the Sacramento, Feather, and Bear Rivers and Butte Creek overflowed, floodwater filled the low lying American and Sutter Basins in the center of the survey area. As the floodwater subsided and drained slowly back into the main channels, clay and silt from a variety of sources settled out of suspension and were deposited. The 1911 Soil Survey of the Marysville Area, California (*13*), in referring to "that part of the area now occupied by American and Sutter basin..." states, "The formation of this soil is still going on, additions being made by material laid down annually during the overflowing of this section by floodwater of the rivers. The amount of material which is annually deposited in these basins is enormous, averaging close to 2 inches in thickness." The surface age of these deposits then may be as young as 50 years in areas that were the last to be protected by levees.

The clay deposited in the basins, dominantly montmorillonitic, swells when wetted by rains or flooding and shrinks during hot, dry summers, leaving cracks 2 to 3 feet deep in the soils. These cracks were repeatedly filled with surface soil containing organic matter. A large amount of organic matter from decaying tules and marsh grasses present in these areas accumulated when the unreclaimed soils were poorly drained and frequently flooded. This accumulation of organic matter gave the Oswald, Capay, Clear Lake, and Subaco soils their dark-colored surface layer. Poor drainage in these soils has led to the segregation and accumulation of iron and manganese oxides in the form of small, rounded concretions or pellets; also, under the poorly drained anerobic conditions iron compounds were reduced, contributing to the already dark color of the organic matter in the Clear Lake and Subaco soils. The self-churning action of these soils resulting from shrinking and swelling has prevented the development of most other morphological characteristics.

A few areas in the American Basin are underlain by a siltstone layer that extends from the alluvial terrace in the northeastern and eastern parts of the county. After heavy rains, or when the basin is flooded, water is perched on top of this siltstone layer. Galt and Jacktone soils have a thin silica- and iron-cemented duripan that formed on top of this siltstone layer through hydrolysis and precipitation in place. Other morphological characteristics of these soils are similar to those of the Oswald and Subaco soils. Drainage in the basins has been improved through the construction of deep drains and flood control structures. As a result of improved drainage and leaching by irrigation water, many of these soils that once had salt accumulations have now been reclaimed.

Alluvial terraces.—The gently sloping alluvial terrace in the northeastern part of the survey area, in the vicinity of Yuba City and Live Oak, was only rarely flooded. Many of the soils on this terrace formed in alluvium deposited over unrelated siltstone. The siltstone varies in thickness from a few inches to many feet. On the eastern part of the terrace, near the Feather River, the siltstone layer is thinnest. Here the layer may be 1 foot to 10 feet thick. Depth to the siltstone layer is extremely variable over short distances in this area. Moving westward toward the Butte and Sutter Basins, the depth to the siltstone layer becomes less variable and thickness of the siltstone layer increases considerably. Most of the soils on the present surface are of late Pleistocene age (29,000 to 42,000 years old) and are of the Modesto Formation (*3*).

The combination of a woodland-grass cover and a Mediterranean climate as modified by time has contributed to the weathering and development that has taken place in these soils. The warm temperature favors rapid chemical weathering, and water from spring rains moving through the soils leaches dissolved minerals and suspended material, including clay, downward in the profile. The native vegetation, mainly an open canopy of valley oak with an understory of perennial grasses, accounts for the accumulation of organic matter on the surface of these soils.

The soils on the terrace have distinctive morphological characteristics. Clay content and soil profile development increase with distance to the west from the Feather River. Conejo and Tisdale soils, which are closest to the river, have a mollic epipedon, a cambic horizon, and about 18 to 35 percent clay. Gridley and Marcum soils, farther from the river and bordering the basin soils, have a mollic epipedon and an argillic horizon with about 35 to 60 percent clay. Formation of a B horizon seems to have progressed more rapidly in the finer textured soils, because the alluvial parent material for the entire area was probably deposited as overbank sediment at about the same time.

The terrace is bisected by Gilsizer Slough and several other narrow drainage channels. These drainage channels carried, or in some cases still do carry, runoff from precipitation or rare floods. Garretson Variant soils, occupying one young alluvial channel, do not have diagnostic subsurface horizons.

A small area of Yuvas soils south of Yuba City, near Wilson School, is a remnant of soils that once covered much of the low alluvial terrace as far north as Live Oak. Yuvas soils have an ochric epipedon, a clayey argillic horizon, and a duripan over siltstone. The original Yuvas surface north of Yuba City has been eroded; only small remnants, commonly less than 1 acre, are located north of Yuba City. Elevation in the area north of Yuba City is 65 feet, and elevation of the main body of Yuvas soils near Wilson School is about 35 to 40 feet. Yuvas soils are of similar age, have similar characteristics, and formed under circumstances similar to those under which the soils on the alluvial terrace in the southeastern part of the survey area formed.

The gently sloping alluvial terrace in the southeastern part of the area, near Placer County, has been only rarely flooded. The soils in this area formed in alluvium derived from mixed sources, mainly granitic alluvium. These soils are the oldest in the county, probably of middle Pleistocene age (130,000 to 450,000 years old) and formed on the middle or lower units of the Riverbank Formation (*9*). Time and the cyclic climate of the area have had the effect of forming very distinct morphological characteristics in these soils. Warm temperatures and abundant rains dissolved and translocated silica, iron, and clay and other materials to a uniform depth. As a result of these processes, San Joaquin soils have a silica- and iron-cemented duripan underlying an argillic horizon that has a high clay content and an abrupt upper boundary. These soils probably represent several episodes of soil formation, with the lithologic discontinuity between the duripan and the argillic horizon providing evidence that the duripan is a remnant of a relict paleosol. The surface layer of the San Joaquin and associated Cometa soils is light colored because the climate favors rapid decomposition of organic matter. In addition, the native grass on these soils was not dense because much of the precipitation ran off or was not retained for plant growth as a result of the low available water capacity of the soils.

Uplands.—The uplands in the survey area are restricted to the volcanic Sutter Buttes in the north-central part of the area. The upland soils are formed in four kinds of parent material. The parent material in the central part of the Buttes is predominantly an andesite and rhyolite extrusion of about Pliocene age (2.5 million years old) (*20*). The age of the Ocraig soils that formed in these materials is not necessarily related, however, to the geologic age of the parent rock but is more closely related to the erosion cycle. A combination of steep, actively eroding slopes and parent material that resists weathering has kept soil formation to a minimum. As a result, Ocraig soils do not have a diagnostic horizon.

The volcanic extrusion uplifted sedimentary sandstone and shale on the Sacramento Valley floor of chiefly upper Cretaceous age (65 to 100 million years old). This uplifted sediment surrounds the central igneous core. The sandstone and shale sediment is easily weathered; however, it is less sloping and therefore is not so erodible as the volcanic parent material. The shale sediment weathered to form the montmorillonitic clay in the Altamont soils. Dibble soils formed in the less easily weathered sandstone. Dibble soils commonly occupy the higher, convex ridgetops because they formed in the more slowly weathering sandstone. Dibble soils have a distinct argillic horizon. Horizon development in the Altamont soils has been impeded by shrinking and swelling.

The Palls and Stohlman soils, on the outer part of the Buttes, developed on a lahar that was formed in an explosive period of the volcano during the late Pliocene (1.5 to 2.0 million years ago). This parent material resists weathering in a way very similar to the way in which the central igneous core does. Palls and Stohlman soils have metastable slopes and as a result have been sufficiently stable for a weak argillic horizon to develop.

The last type of parent material is alluvium derived from the other three types of parent material in the Buttes. Olashes soils formed in alluvium on fans and in valleys around the Buttes. Soil formation in the Olashes soils has proceeded in a manner similar to the way in which the Marcum soils formed on the alluvial terrace.

Frequent fires and a climate with warm, moist spring and fall conditions that favor the rapid decomposition of roots and other organic matter have limited the accumulation of organic matter in most of the soils on the Buttes. A slightly cooler and moister climate on the north side of the Sutter Buttes has produced a canopy of oak; however, these vegetative and climatic influences have had no recognizable effect on soil formation and on soil properties.

Soil Horizonation

Many soils in the survey area have several horizons. San Joaquin soils have an A horizon, a well developed B horizon, and a duripan in the C horizon. Other soils have only weak or indistinct horizons. Ocraig soils have only a thin A horizon. The differentiation of horizons in these soils is the result of one or more of the following processes: additions, removals, transfers, and transformations (*12*).

The soils in the survey area have an A horizon as a result of additions of organic matter. Conejo soils, for example, have a deep, dark-colored A horizon as a result of constant additions of organic matter from decaying plants. Organic matter is prominent to a depth of 20 to 30 inches in the Conejo soils.

Many soils in Sutter County have a B horizon as a result of the transformation of primary minerals into silicate clay in the A horizon. This silicate clay is subsequently removed by eluviation from the A horizon and is transferred to the subsoil to form an argillic B horizon. Gridley soils have a strong B horizon that developed in alluvium on top of siltstone, which stopped the downward transfer of clay.

San Joaquin soils have a strongly cemented duripan in the 2C horizon. Cementation is a result of transformation in place of volcanic ash into silica, and of primary minerals into sesquioxides, mainly iron and alumina, to form cementing agents. Some silica and sesquioxides have also been transferred to the 2C horizon from overlying horizons.

Additions, removals, transfers, and transformations in soils do not necessarily result in horizon differentiation. Clear Lake soils do not exhibit horizon differentiation because they contain deep-cracking clay and because of the physical transfer of surface soil down the cracks into the lower part of the profile.

Finally, "the variety of changes proceeding during the differentiation of horizons in a profile depend themselves upon a host of simpler processes such as hydration, oxidation, solution, leaching, precipitation, and mixing. These simpler and more basic reactions proceed in all soils. They are controlled in their turn by factors such as time, climate, living organisms, parent materials and topography" (*12*).

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Glossary

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

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

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

Alluvial cone. The material washed down the sides of mountains and hills by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep, conical mass descending equally in all directions from the point of issue.

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

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

Animal-unit-month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Arroyo. The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

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—

	Inches
Very low	0 to 2.5
Low	2.5 to 5.0
Moderate	5.0 to 7.5
High	7.5 to 10.0
Very high	More than 10.0

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

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

Basin. A broad structural lowland, commonly elongated and many miles across, between mountain ranges.

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

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

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

Breast height. An average height of 4 1/2 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 reduce or eliminate competition of woody vegetation to allow understory grasses and forbs to recover, or to make conditions favorable for reseeding. It increases production of forage, which reduces erosion. Brush management may improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

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

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

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

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.

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

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

Chemical treatment. Control of unwanted vegetation by use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter, in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Clay skin. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay film.

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

Coarse fragments. Mineral or rock particles larger than 2 millimeters in diameter.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

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

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures 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.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

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

Conservation cropping system. Growing crops in combination with needed cultural and management practices. If soil improving crops and practices used in the system more than offset the soil depleting crops and deteriorating practices, then it is a good conservation cropping system. 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.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

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

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

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

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.

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

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

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

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

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

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

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—These soils have very high and high hydraulic conductivity and low water holding capacity. They are not suited to crop production unless irrigated.
Somewhat excessively drained.—These soils have high hydraulic conductivity and low water holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.
Well drained.—These soils have intermediate water holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.
Moderately well drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless artificial drainage is provided. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.
Somewhat poorly drained.—These soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless artificial drainage is provided. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.
Poorly drained.—These soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.
Very poorly drained.—These soils are wet to the surface most of the time. They are wet enough to prevent the growth of important crops (except rice) unless artificially drained.

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

Draw. A small stream valley, generally more open and with broader bottom land than a ravine or gulch.

Duff. A term used to identify 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.

Duripan. A subsurface soil horizon that is cemented by silica and sesqueoxides.

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.

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.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood

plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature; for example, fire that exposes the surface.

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

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

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 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.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

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.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry 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, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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

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

Foot slope. The inclined surface at the base of a hill.

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

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.

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.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

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

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, 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 (geology). Water filling all the unblocked pores of underlying material below the water table.

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

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

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head out. To form a flower head.

High-residue crops. Crops such as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

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

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

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

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

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the number 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

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

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

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.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

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

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

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

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

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

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.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

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.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

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

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

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

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

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

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

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

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 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.

Light textured soil. Sand and loamy sand.

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.

Low-residue crops. Crops such as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

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

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.

Metastable slope. A slope that is relatively stable at the present time, but one that may become active if the environmental balance is disturbed by activities such as road construction or distruction of vegetation.

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, and fine sandy loam.

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

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

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

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 and considerable bare-rock surface. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

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

Natural levees. Wedge-shaped deposits of the coarsest textured, suspended-load material that formed long, low ridges on channel banks and that slope gently away from the stream.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

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

Observed rooting depth. Depth to which roots have been observed to penetrate.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

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

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

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

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

Percolation. The downward movement of water through the soil.

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

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

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

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

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

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

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

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

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

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

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

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

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

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

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

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

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 increases the vigor and reproduction of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

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

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

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

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

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

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 is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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

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

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

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

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

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

Sandstone. Sedimentary rock containing dominantly sand-size particles.

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

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

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

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

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

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. The mineral form is called quartz.

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.

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.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

	Percent
Nearly level	0 to 2
Gently sloping	2 to 5
Moderately sloping	5 to 9
Strongly sloping	9 to 15
Moderately steep	15 to 30
Steep	30 to 50
Very steep	50 and higher 75

Slope (in tables). Slope is great enough that special practices are required to insure 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 (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

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

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

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

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

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

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

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 6 to 15 inches (15 to 38 centimeters) in length if flat.

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

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

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

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

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

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.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

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

Tail water. The water just downstream of a structure.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

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

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay* *loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

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

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

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

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

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

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.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1941-70 at Marysville, CA]

Month	Average temperature	Average precipitation
	°F	In
January	46.0	3.99
February	50.1	3.86
March	54.8	2.68
April	60.6	1.74
May	66.8	0.80
June	73.7	0.22
July	79.0	0.01
August	77.0	0.02
September	73.5	0.23
October	64.5	1.13
November	54.1	2.03
December	47.0	3.88
Yearly:	62.3	20.59

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1941-70 at Marysville, CA]

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	January 13	February 11	March 11
2 years in 10 later than--	January 2	February 2	March 2
5 years in 10 later than--	---	January 15	February 13
First freezing temperature in fall:			
1 year in 10 earlier than--	December 31	November 24	November 7
2 years in 10 earlier than--	---	December 2	November 16
5 years in 10 earlier than--	---	---	December 1

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
101	Altamont-Dibble complex, 9 to 30 percent slopes	2,170	0.6
102	Altamont-Dibble complex, 30 to 50 percent slopes	1,265	0.3
103	Byington silt loam, 0 to 2 percent slopes	4,435	1.1
104	Capay silty clay, 0 to 2 percent slopes	23,335	6.0
105	Capay silty clay, occasionally flooded, 0 to 2 percent slopes	2,510	0.6
106	Capay silty clay, frequently flooded, 0 to 2 percent slopes	3,370	0.9
107	Capay silty clay, siltstone substratum, 0 to 2 percent slopes	5,655	1.5
108	Capay silty clay, wet, 0 to 2 percent slopes	10,785	2.8
109	Capay clay, hardpan substratum, 0 to 2 percent slopes	2,010	0.5
110	Clear Lake silt loam, 0 to 2 percent slopes	1,990	0.5
111	Clear Lake silt loam, frequently flooded, 0 to 2 percent slopes	2,195	0.6
112	Clear Lake clay, 0 to 2 percent slopes	30,880	7.9
113	Clear Lake clay, frequently flooded, 0 to 2 percent slopes	2,135	0.5
114	Clear Lake clay, hardpan substratum, 0 to 2 percent slopes	1,955	0.5
115	Clear Lake clay, siltstone substratum, 0 to 2 percent slopes	3,820	1.0
116	Clear Lake clay, siltstone substratum, frequently flooded, 0 to 2 percent slopes	1,060	0.3
117	Columbia fine sandy loam, 0 to 2 percent slopes	4,685	1.2
118	Columbia fine sandy loam, channeled, 0 to 2 percent slopes	1,695	0.4
119	Columbia fine sandy loam, clay substratum, 0 to 2 percent slopes	1,475	0.4
120	Columbia fine sandy loam, clay substratum, frequently flooded, 0 to 2 percent slopes	1,050	0.3
121	Columbia fine sandy loam, frequently flooded, 0 to 2 percent slopes	4,150	1.1
122	Columbia loam, 0 to 2 percent slopes	1,325	0.3
123	Cometa loam, 0 to 2 percent slopes	11,785	3.0
124	Conejo loam, 0 to 2 percent slopes	8,455	2.2
125	Conejo loam, siltstone substratum, 0 to 2 percent slopes	1,710	0.4
126	Conejo-Tisdale complex, 0 to 2 percent slopes	23,110	5.9
127	Conejo-Urban land complex, 0 to 2 percent slopes	4,585	1.2
128	Exeter sandy loam, 0 to 2 percent slopes	590	0.2
129	Galt clay, 0 to 2 percent slopes	2,710	0.7
130	Galt clay, frequently flooded, 0 to 2 percent slopes	1,815	0.5
131	Garretson Variant loam, 0 to 2 percent slopes	945	0.2
132	Gridley clay loam, 0 to 1 percent slopes	9,905	2.5
133	Holillipah loamy sand, 0 to 2 percent slopes	2,485	0.6
134	Holillipah loamy sand, channeled, 0 to 2 percent slopes	1,355	0.3
135	Holillipah loamy sand, frequently flooded, 0 to 2 percent slopes	2,125	0.5
136	Holillipah sandy loam, 0 to 2 percent slopes	375	0.1
137	Jacktone clay, 0 to 2 percent slopes	780	0.2
138	Liveoak sandy clay loam, 0 to 1 percent slopes	5,275	1.4
139	Liveoak Variant-Galt Variant complex, frequently flooded, 0 to 2 percent slopes	1,860	0.5
140	Marcum clay loam, 0 to 2 percent slopes	3,930	1.0
141	Marcum clay loam, siltstone substratum, 0 to 1 percent slopes	6,375	1.6
142	Marcum clay loam, occasionally flooded, 0 to 2 percent slopes	1,525	0.4
143	Marcum-Gridley clay loams, 0 to 1 percent slopes	13,990	3.6
144	Nueva loam, 0 to 1 percent slopes	16,085	4.1
145	Nueva loam, occasionally flooded, 0 to 1 percent slopes	1,190	0.3
146	Nueva loam, wet, 0 to 1 percent slopes	2,695	0.7
147	Ocraig gravelly coarse sandy loam, 50 to 75 percent slopes	1,415	0.4
148	Ocraig very stony coarse sandy loam, 30 to 50 percent slopes	640	0.2
149	Ocraig-Rock outcrop complex, 50 to 75 percent slopes	1,670	0.4
150	Olashes sandy loam, 0 to 2 percent slopes	15,915	4.1
151	Olashes sandy loam, 2 to 5 percent slopes	720	0.2
152	Olashes sandy loam, frequently flooded, 0 to 2 percent slopes	2,725	0.7
153	Oswald clay, 0 to 2 percent slopes	18,660	4.8
154	Oswald clay, frequently flooded, 0 to 2 percent slopes	5,435	1.4
155	Palls-Bohna Variant association, 30 to 60 percent slopes	3,845	1.0
156	Palls-Stohlman stony sandy loams, 9 to 30 percent slopes	11,575	3.0
157	Palls-Stohlman stony sandy loams, cool, 9 to 30 percent slopes	7,755	2.0
158	San Joaquin sandy loam, 0 to 2 percent slopes	11,285	2.9
159	San Joaquin sandy loam, occasionally flooded, 0 to 2 percent slopes	1,085	0.3
160	San Joaquin-Arents-Durochrepts complex, 0 to 1 percent slopes	2,915	0.8
161	Shanghai fine sandy loam, channeled, 0 to 2 percent slopes	1,025	0.3
162	Shanghai silt loam, 0 to 2 percent slopes	9,095	2.3
163	Shanghai silt loam, clay substratum, 0 to 2 percent slopes	1,440	0.4
164	Shanghai silt loam, clay substratum, frequently flooded, 0 to 2 percent slopes	2,955	0.8
165	Shanghai silt loam, frequently flooded, 0 to 2 percent slopes	1,030	0.3
166	Shanghai silt loam, wet, 0 to 2 percent slopes	1,065	0.3
167	Shanghai silty clay loam, 0 to 2 percent slopes	5,620	1.4

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
168	Shanghai Variant loamy sand, 0 to 1 percent slopes	760	0.2
169	Snelling loam, 0 to 2 percent slopes	1,475	0.4
170	Snelling loam, occasionally flooded, 0 to 2 percent slopes	1,870	0.5
171	Stohlman-Palls stony sandy loams, 30 to 50 percent slopes	550	0.1
172	Stohlman-Palls stony sandy loams, cool, 30 to 50 percent slopes	5,455	1.4
173	Subaco clay, 0 to 2 percent slopes	11,585	3.0
174	Tisdale clay loam, 0 to 2 percent slopes	7,405	1.9
175	Yuvas loam, 0 to 2 percent slopes	6,510	1.7
176	Yuvas loam, frequently flooded, 0 to 2 percent slopes	1,055	0.3
	Water	4,340	1.1
	Total	388,480	100.0

TABLE 4.--YIELDS PER ACRE OF CROPS

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil. Soils not used for crops are not listed]

Soil name and map symbol	Walnuts	Peaches	Prunes	Tomatoes	Rice	Corn	Wheat
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
103 Byington	---	---	---	---	3.75	---	2.5
104 Capay	---	---	---	25	3.75	3.5	2.5
105 Capay	---	---	---	---	3.75	3.5	2.5
106 Capay	---	---	---	20	3.75	3.0	---
107, 108 Capay	---	---	---	25	3.75	3.5	2.5
109 Capay	---	---	---	25	3.75	3.5	2.5
110 Clear Lake	---	---	---	22	3.75	4.0	3.0
111 Clear Lake	---	---	---	20	3.75	2.5	---
112 Clear Lake	---	---	---	25	3.75	3.5	2.5
113 Clear Lake	---	---	---	20	3.75	3.0	---
114 Clear Lake	---	---	---	25	3.75	3.5	2.5
115 Clear Lake	---	---	---	25	3.75	3.5	2.5
117 Columbia	2.0	25	4.0	22	---	4.25	2.5
118 Columbia	2.0	15	3.0	20	---	---	---
119 Columbia	---	15	2.5	22	3.75	4.25	2.5
120 Columbia	---	---	---	20	3.75	3.5	---
121 Columbia	2.0	15	3.0	20	---	---	---
122 Columbia	2.0	20	4.0	22	---	4.0	3.0
123 Cometa	---	---	---	---	3.75	---	---
124 Conejo	2.0	25	4.5	27	---	4.5	3.0
125 Conejo	1.8	20	4.0	25	---	4.25	3.0

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Walnuts	Peaches	Prunes	Tomatoes	Rice	Corn	Wheat
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
126---------------------- Conejo-Tisdale	---	18	3.0	22	---	4.0	3.0
128---------------------- Exeter	---	---	---	---	3.75	---	---
129, 130----------------- Galt	---	---	---	---	3.75	---	---
131---------------------- Garretson Variant	1.8	20	4.0	22	---	3.5	---
132---------------------- Gridley	---	15	2.5	20	3.75	4.0	2.5
133---------------------- Holillipah	1.8	20	3.5	20	---	3.0	---
135---------------------- Holillipah	1.8	---	3.0	---	---	3.0	---
136---------------------- Holillipah	1.8	25	---	20	---	3.0	2.5
137---------------------- Jacktone	---	---	---	20	3.75	3.5	---
138---------------------- Liveoak	2.0	25	4.5	---	---	---	---
139---------------------- Liveoak Variant-Galt Variant	---	---	---	---	3.75	---	---
140---------------------- Marcum	0.9	18	3.5	27	3.75	4.5	3.0
141---------------------- Marcum	0.9	18	3.0	27	3.75	4.0	3.0
142---------------------- Marcum	---	---	---	---	3.75	4.0	---
143---------------------- Marcum-Gridley	---	17	3.0	24	3.75	4.0	2.5
144---------------------- Nueva	2.0	25	4.0	27	3.75	4.25	3.0
145---------------------- Nueva	---	---	---	---	3.75	---	---
146---------------------- Nueva	---	---	4.0	27	3.75	4.25	3.0
150---------------------- Olashes	2.0	25	4.5	---	3.75	---	---
151---------------------- Olashes	---	---	---	---	---	---	1.0
152---------------------- Olashes	---	---	---	---	3.75	---	---
153---------------------- Oswald	---	---	2.0	20	3.75	3.5	2.5

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Walnuts	Peaches	Prunes	Tomatoes	Rice	Corn	Wheat
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
154: Oswald	---	---	---	---	3.75	3.5	---
158: San Joaquin	---	---	---	---	3.75	---	---
159: San Joaquin	---	---	---	---	3.75	---	---
160*: San Joaquin-Arents-Durochrepts	---	---	---	---	3.75	---	---
161: Shanghai	---	13	3.0	20	---	3.75	---
162: Shanghai	2.0	15	4.5	27	3.75	4.25	3.0
163: Shanghai	---	---	---	22	3.75	4.25	3.0
164: Shanghai	---	---	---	20	3.75	3.5	---
165: Shanghai	---	13	3.0	20	---	3.5	---
166: Shanghai	---	---	3.0	---	---	---	---
167: Shanghai	2.0	15	4.5	27	3.75	4.25	3.0
168: Shanghai Variant	1.0	---	---	---	---	3.0	---
169: Snelling	2.0	15	4.5	---	3.75	---	---
170: Snelling	---	---	---	---	3.75	---	---
173: Subaco	---	---	---	20	3.75	3.5	2.5
174: Tisdale	---	12	2.5	20	3.75	3.0	---
175: Yuvas	---	---	2.0	---	3.75	3.0	---
176: Yuvas	---	---	---	---	3.75	2.5	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
101*, 102*:					
Altamont	Clayey (18e)	Favorable	6,000	Soft chess	30
		Normal	3,600	Wild oat	25
		Unfavorable	1,000	Mediterranean barley	15
				Burclover	5
				Ripgut brome	5
				Filaree	5
				Foxtail fescue	5
Dibble	Clayey (18e)	Favorable	6,000	Soft chess	30
		Normal	3,600	Wild oat	25
		Unfavorable	1.000	Mediterranean barley	15
				Burclover	5
				Filaree	5
				Foxtail fescue	5
148 Ocraig	Stony Very Shallow Loamy (18e)	Favorable	1,800	Soft chess	30
		Normal	1,200	Wild oat	25
		Unfavorable	500	Filaree	5
				Purple needlegrass	5
155*:					
Palls	Blue Oak/annual Grass-Stony Coarse Loamy (18d).	Favorable	5,000	Soft chess	25
		Normal	2,500	Wild oat	20
		Unfavorable	1,000	Filaree	10
				Ripgut brome	5
				Common geranium	5
				Clover	5
				Blue oak	5
Bohna Variant	Blue Oak/annual Grass-Loamy (18d).	Favorable	3,000	Soft chess	25
		Normal	1,800	Mediterranean barley	10
		Unfavorable	1,000	Ripgut brome	10
				Wild oat	10
				Filaree	10
				Poison-oak	10
				Bedstraw	5
				California melicgrass	5
				Minerslettuce	5
				Foxtail fescue	5
				Blue oak	5
				Interior live oak	5
156*:					
Palls	Stony Coarse Loamy (18e)	Favorable	3,200	Soft chess	25
		Normal	2,000	Wild oat	20
		Unfavorable	1,000	Filaree	10
				Silver hairgrass	10
				Ripgut brome	5
				Common geranium	5
				Clover	5
Stohlman	Stony Shallow Loamy (18e)	Favorable	2,800	Soft chess	25
		Normal	1,800	Ripgut brome	15
		Unfavorable	800	Wild oat	15
				Filaree	10
				Red brome	5
				Clover	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
157*:					
Palls	Blue Oak/annual Grass-Stony Coarse Loamy (18d).	Favorable	5,000	Soft chess	25
		Normal	2,500	Wild oat	20
		Unfavorable	1,000	Filaree	10
				Mediterranean barley	10
				Ripgut brome	5
				Common geranium	5
				Clover	5
				Blue oak	5
Stohlman	Blue Oak/annual Grass-Stony Shallow Loamy (18d).	Favorable	3,600	Soft chess	25
		Normal	2,400	Ripgut brome	15
		Unfavorable	800	Wild oat	15
				Filaree	10
				Purple needlegrass	5
				Clover	5
				Blue oak	5
171*:					
Stohlman	Stony Shallow Loamy (18e)	Favorable	2,800	Soft chess	25
		Normal	1,800	Ripgut brome	15
		Unfavorable	800	Wild oat	15
				Filaree	10
				Red brome	5
				Clover	5
Palls	Stony Coarse Loamy (18e)	Favorable	3,200	Soft chess	25
		Normal	2,000	Wild oat	20
		Unfavorable	1,000	Filaree	10
				Silver hairgrass	10
				Ripgut brome	5
				Common geranium	5
				Clover	5
172*:					
Stohlman	Blue Oak/annual Grass-Stony Shallow Loamy (18d).	Favorable	3,600	Soft chess	25
		Normal	2,400	Ripgut brome	15
		Unfavorable	800	Wild oat	15
				Filaree	10
				Purple needlegrass	5
				Clover	5
				Blue oak	5
Palls	Blue Oak/annual Grass-Stony Coarse Loamy (18d).	Favorable	5,000	Soft chess	25
		Normal	2,500	Wild oat	20
		Unfavorable	1,000	Filaree	10
				Mediterranean barley	10
				Ripgut brome	5
				Common geranium	5
				Clover	5
				Blue oak	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
101*:					
Altamont	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope, too clayey.
Dibble	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
102*:					
Altamont	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, too clayey.
Dibble	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
103 Byington	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Severe: erodes easily.	Slight.
104 Capay	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
105 Capay	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
106 Capay	Severe: flooding.	Moderate: flooding, too clayey.	Severe: flooding.	Moderate: too clayey, flooding.	Severe: flooding, too clayey.
107, 108 Capay	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
109 Capay	Severe: flooding.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
110 Clear Lake	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.	Slight.
111 Clear Lake	Severe: flooding.	Moderate: flooding, dusty.	Severe: flooding.	Severe: erodes easily.	Severe: flooding.
112 Clear Lake	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
113 Clear Lake	Severe: flooding.	Moderate: flooding, too clayey.	Severe: flooding.	Moderate: too clayey, flooding.	Severe: flooding, too clayey.
114, 115 Clear Lake	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
116 Clear Lake	Severe: flooding.	Moderate: flooding, too clayey.	Severe: flooding.	Moderate: too clayey, flooding.	Severe: flooding, too clayey.
117 Columbia	Severe: flooding.	Slight	Slight	Slight	Moderate: droughty.

See footnote at end of table.

TABLE 6.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
118 Columbia	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
119 Columbia	Severe: flooding.	Slight	Slight	Slight	Moderate: droughty.
120, 121 Columbia	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
122 Columbia	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
123 Cometa	Moderate: percs slowly, dusty.	Moderate: percs slowly, dusty.	Moderate: percs slowly.	Severe: erodes easily.	Moderate: droughty.
124 Conejo	Slight	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
125 Conejo	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
126*:					
Conejo	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
Tisdale	Slight	Slight	Slight	Slight	Moderate: thin layer.
127*:					
Conejo	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
Urban land.					
128 Exeter	Slight	Slight	Moderate: small stones.	Slight	Moderate: thin layer.
129 Galt	Severe: flooding.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
130 Galt	Severe: flooding.	Moderate: flooding, too clayey.	Severe: flooding.	Moderate: too clayey, flooding.	Severe: flooding, too clayey.
131 Garretson Variant	Slight	Slight	Slight	Slight	Slight.
132 Gridley	Slight	Slight	Slight	Slight	Moderate: thin layer.
133 Holillipah	Severe: flooding.	Slight	Slight	Slight	Moderate: droughty.
134, 135 Holillipah	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
136 Holillipah	Severe: flooding.	Slight	Slight	Slight	Moderate: droughty.
137 Jacktone	Severe: flooding.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness.	Moderate: wetness, too clayey.	Severe: too clayey.
138 Liveoak	Slight	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 6.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
139*:					
Liveoak Variant	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Severe: erodes easily.	Severe: flooding.
Galt Variant	Severe: flooding.	Moderate: flooding, wetness, percs slowly.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
140 Marcum	Severe: flooding.	Slight	Slight	Slight	Slight.
141 Marcum	Slight	Slight	Slight	Slight	Slight.
142 Marcum	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
143*:					
Marcum	Slight	Slight	Slight	Slight	Slight.
Gridley	Slight	Slight	Slight	Slight	Moderate: thin layer.
144 Nueva	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.	Slight.
145 Nueva	Severe: flooding.	Moderate: dusty.	Moderate: flooding, dusty.	Severe: erodes easily.	Moderate: flooding.
146 Nueva	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.	Slight.
147 Ocraig	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: slope, thin layer.
148 Ocraig	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: slope, thin layer.
149*:					
Ocraig	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, small stones.	Severe: slope.	Severe: slope, thin layer.
Rock outcrop.					
150 Olashes	Slight	Slight	Slight	Slight	Slight.
151 Olashes	Slight	Slight	Moderate: slope.	Slight	Slight.
152 Olashes	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
153 Oswald	Severe: flooding.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness.	Moderate: wetness, too clayey.	Severe: too clayey.

See footnote at end of table.

TABLE 6.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
154 Oswald	Severe: flooding.	Moderate: flooding, wetness, too clayey.	Severe: flooding.	Moderate: wetness, too clayey, flooding.	Severe: flooding, too clayey.
155*:					
Palls	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
Bohna Variant	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
156*, 157*:					
Palls	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: slope.
Stohlman	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.	Severe: slope, thin layer.
158 San Joaquin	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Moderate: droughty, thin layer.
159 San Joaquin	Severe: flooding.	Moderate: percs slowly.	Moderate: flooding, percs slowly.	Slight	Moderate: droughty, flooding, thin layer.
160*:					
San Joaquin	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Moderate: droughty, thin layer.
Arents.					
Durochrepts.					
161 Shanghai	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Severe: erodes easily.	Severe: flooding.
162 Shanghai	Severe: flooding.	Moderate: dusty.	Moderate: dusty.	Severe: erodes easily.	Slight.
163 Shanghai	Severe: flooding.	Moderate: dusty.	Slight	Severe: erodes easily.	Slight.
164, 165, 166 Shanghai	Severe: flooding.	Moderate: flooding, dusty.	Severe: flooding.	Severe: erodes easily.	Severe: flooding.
167 Shanghai	Severe: flooding.	Slight	Slight	Severe: erodes easily.	Slight.
168 Shanghai Variant	Severe: flooding.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Slight.
169 Snelling	Moderate: dusty.	Moderate: dusty.	Moderate: small stones, dusty.	Severe: erodes easily.	Slight.

See footnote at end of table.

TABLE 6.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
170------------------- Snelling	Severe: flooding.	Moderate: dusty.	Moderate: small stones, flooding.	Severe: erodes easily.	Moderate: flooding.
171*, 172*:					
Stohlman-------------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: slope, thin layer.
Palls----------------	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: slope.
173------------------- Subaco	Severe: flooding.	Moderate: wetness, too clayey.	Moderate: too clayey, wetness.	Moderate: wetness, too clayey.	Severe: too clayey.
174------------------- Tisdale	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: thin layer.
175------------------- Yuvas	Severe: flooding.	Moderate: percs slowly, dusty.	Moderate: percs slowly, dusty.	Moderate: dusty.	Moderate: thin layer.
176------------------- Yuvas	Severe: flooding.	Moderate: flooding, wetness, percs slowly.	Severe: flooding.	Moderate: wetness, flooding, dusty.	Severe: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
101*:											
Altamont	Fair	Good	Good	Very poor.	Very poor.	Very poor.	Very poor.	Fair	---	---	Fair.
Dibble	Fair	Good	Good	Poor	Good	Very poor.	Very poor.	Fair	---	---	Good.
102*:											
Altamont	Very poor.	Very poor.	Good	Very poor.	Poor	Very poor.	Very poor.	---	---	---	Fair.
Dibble	Very poor.	Very poor.	Good	Poor	Fair	Very poor.	Very poor.	---	---	---	Good.
103 Byington	Good	Good	Good	Good	Good	Good	Good	Good	---	Good	---
104 Capay	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
105 Capay	Fair	Fair	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
106 Capay	Fair	Fair	Fair	Very poor.	Very poor.	Good	Good	Poor	---	Good	---
107 Capay	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
108 Capay	Fair	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
109 Capay	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
110 Clear Lake	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
111 Clear Lake	Fair	Fair	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
112 Clear Lake	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
113 Clear Lake	Fair	Fair	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
114 Clear Lake	Good	Good	Good	Very poor.	Very poor.	Good	Good	Good	---	Good	---
115 Clear Lake	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
116 Clear Lake	Fair	Fair	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
117 Columbia	Good	Good	Good	Fair	Good	Good	Fair	Good	---	Fair	---
118 Columbia	Fair	Good	Good	Good	Good	Good	Fair	Fair	---	Good	---

See footnote at end of table.

TABLE 7.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
119----------------- Columbia	Good	Good	Good	Fair	Good	Good	Good	Good	---	Good	---
120----------------- Columbia	Fair	Fair	Good	Fair	Good	Good	Good	Fair	---	Good	---
121----------------- Columbia	Fair	Good	Good	Good	Good	Good	Fair	Fair	---	Good	---
122----------------- Columbia	Good	Good	Good	Fair	Good	Good	Fair	Good	---	Fair	---
123----------------- Cometa	Fair	Good	Fair	Very poor.	Fair	Good	Good	Fair	---	Good	---
124----------------- Conejo	Good	Good	Good	Good	Good	Good	Fair	Good	---	Fair	---
125----------------- Conejo	Good	Good	Good	Fair	Good	Good	Fair	Good	---	Fair	---
126*:											
Conejo-------------	Good	Good	Good	Fair	Good	Good	Fair	Good	---	Fair	---
Tisdale------------	Good	Good	Good	Poor	Fair	Good	Fair	Good	---	Fair	---
127*:											
Conejo-------------	Good	Good	Good	Fair	Good	Good	Fair	Good	---	Fair	---
Urban land.											
128----------------- Exeter	Fair	Good	Good	Poor	Poor	Good	Good	Good	---	Good	---
129----------------- Galt	Good	Good	Good	Very poor.	Very poor.	Good	Good	Good	---	Good	---
130----------------- Galt	Fair	Fair	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
131----------------- Garretson Variant	Good	Good	Good	Good	Good	Good	Fair	Good	---	Fair	---
132----------------- Gridley	Good	Good	Good	Poor	Fair	Good	Good	Good	---	Good	---
133----------------- Holillipah	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	---	Very poor.	---
134, 135------------ Holillipah	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	---	Very poor.	---
136----------------- Holillipah	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	---	Very poor.	---
137----------------- Jacktone	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
138----------------- Liveoak	Good	Good	Good	Good	Good	Fair	Fair	Good	---	Fair	---
139*:											
Liveoak Variant----	Fair	Fair	Good	Good	Good	Fair	Good	Good	---	Good	---
Galt Variant-------	Fair	Fair	Good	Poor	Fair	Good	Good	Good	---	Good	---

See footnote at end of table.

TABLE 7.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
140, 141, 142 Marcum	Good	Good	Good	Poor	Fair	Good	Good	Good	---	Good	---
143*:											
Marcum	Good	Good	Good	Poor	Fair	Good	Good	Good	---	Good	---
Gridley	Good	Good	Good	Poor	Fair	Good	Good	Good	---	Good	---
144, 145, 146 Nueva	Good	Good	Good	Good	Good	Good	Fair	Good	---	Fair	---
147, 148 Ocraig	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	---	---	---	Very poor.
149*:											
Ocraig	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	---	---	---	Very poor.
Rock outcrop.											
150, 151 Olashes	Good	Good	Good	Fair	Good	Good	Poor	Good	---	Poor	---
152 Olashes	Fair	Fair	Good	Good	Good	Good	Fair	Fair	---	Fair	---
153 Oswald	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
154 Oswald	Fair	Fair	Good	Very poor.	Very poor.	Good	Good	Poor	---	Good	---
155*:											
Palls	Very poor.	Poor	Good	Poor	Fair	Very poor.	Very poor.	Fair	Poor	---	Fair.
Bohna Variant	Very poor.	Very poor.	Good	Fair	Good	Very poor.	Very poor.	---	Fair	---	Good.
156*, 157*:											
Palls	Poor	Poor	Good	Poor	Fair	Very poor.	Very poor.	Poor	Poor	---	Fair.
Stohlman	Very poor.	Poor	Good	Poor	Poor	Very poor.	Very poor.	---	Poor	---	Fair.
158 San Joaquin	Fair	Good	Fair	Very poor.	Poor	Good	Good	Fair	---	Good	---
159 San Joaquin	Fair	Fair	Fair	Very poor.	Poor	Good	Good	Fair	---	Good	Fair.
160*:											
San Joaquin	Fair	Good	Fair	Very poor.	Poor	Good	Good	Fair	---	Good	---
Arents.											
Durochrepts.											
161 Shanghai	Fair	Fair	Good	Good	Good	Good	Good	Fair	---	Good	---
162 Shanghai	Good	Good	Good	Good	Good	Good	Fair	Good	---	Fair	---

See footnote at end of table.

TABLE 7.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
163----------------- Shanghai	Good	Good	Good	Fair	Fair	Good	Good	Good	---	Good	---
164----------------- Shanghai	Fair	Fair	Good	Fair	Fair	Good	Good	Fair	---	Good	---
165----------------- Shanghai	Fair	Fair	Good	Good	Good	Good	Good	Fair	---	Good	---
166----------------- Shanghai	Fair	Fair	Good	Good	Good	Good	Good	Good	---	Good	---
167----------------- Shanghai	Good	Good	Good	Good	Good	Good	Fair	Good	---	Fair	---
168----------------- Shanghai Variant	Good	Good	Good	Fair	Fair	Good	Fair	Good	---	Fair	---
169----------------- Snelling	Good	Good	Good	Good	Good	Good	Poor	Good	---	Poor	---
170----------------- Snelling	Fair	Fair	Good	Good	Good	Good	Fair	Good	---	Fair	---
171*, 172*:											
Stohlman-----------	Very poor.	Poor	Good	Poor	Poor	Very poor.	Very poor.	---	Poor	---	Fair.
Palls--------------	Very poor.	Poor	Good	Poor	Fair	Very poor.	Very poor.	Fair	Poor	---	Fair.
173----------------- Subaco	Good	Good	Good	Very poor.	Very poor.	Good	Good	Fair	---	Good	---
174----------------- Tisdale	Good	Good	Good	Poor	Fair	Good	Fair	Good	---	Fair	---
175----------------- Yuvas	Fair	Good	Good	Poor	Poor	Good	Fair	Fair	---	Fair	---
176----------------- Yuvas	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	---	Good	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
101*, 102*: Altamont	Severe: cutbanks cave, slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, too clayey.
Dibble	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
103 Byington	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: low strength, wetness, flooding.	Slight.
104 Capay	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
105 Capay	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: too clayey.
106 Capay	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: flooding, too clayey.
107, 108, 109 Capay	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
110 Clear Lake	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Slight.
111 Clear Lake	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: flooding.
112 Clear Lake	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
113 Clear Lake	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: flooding, too clayey.
114, 115 Clear Lake	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
116 Clear Lake	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: flooding, too clayey.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
117--------------- Columbia	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
118--------------- Columbia	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
119--------------- Columbia	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
120--------------- Columbia	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: flooding.	Severe: flooding.
121--------------- Columbia	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
122--------------- Columbia	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
123--------------- Cometa	Moderate: too clayey.	Severe: shrink-swell.	Slight---------	Severe: shrink-swell.	Severe: shrink-swell.	Moderate: droughty.
124--------------- Conejo	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
125--------------- Conejo	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
126*:						
Conejo-----------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Tisdale----------	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: thin layer.
127*:						
Conejo-----------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Urban land.						
128--------------- Exeter	Severe: cemented pan.	Moderate: shrink-swell.	Moderate: cemented pan.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: thin layer.
129--------------- Galt	Severe: cemented pan, cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, cemented pan, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
130--------------- Galt	Severe: cemented pan, cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, cemented pan, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: flooding, too clayey.
131--------------- Garretson Variant	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
132--------------- Gridley	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: thin layer.
133--------------- Hollillipah	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
134, 135----------- Holillipah	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
136---------------- Holillipah	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Moderate: droughty.
137---------------- Jacktone	Severe: cemented pan, cutbanks cave, wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, cemented pan.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
138---------------- Liveoak	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
139*:						
Liveoak Variant--	Moderate: cemented pan, wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Galt Variant-----	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
140---------------- Marcum	Moderate: too clayey.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
141---------------- Marcum	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
142---------------- Marcum	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
143*:						
Marcum-----------	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Gridley----------	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: thin layer.
144---------------- Nueva	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
145---------------- Nueva	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
146---------------- Nueva	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
147, 148----------- Ocraig	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, thin layer.
149*:						
Ocraig-----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, thin layer.
Rock outcrop.						
150, 151----------- Olashes	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
152---------------- Olashes	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
153---------------- Oswald	Severe: cutbanks cave, wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
154---------------- Oswald	Severe: cutbanks cave, wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: flooding, too clayey.
155*:						
Palls-------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
Bohna Variant----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
156*, 157*:						
Palls-------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
Stohlman----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, thin layer.
158---------------- San Joaquin	Severe: cemented pan.	Severe: shrink-swell.	Severe: cemented pan, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: droughty, thin layer.
159---------------- San Joaquin	Severe: cemented pan.	Severe: flooding, shrink-swell.	Severe: flooding, cemented pan, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Moderate: droughty, flooding, thin layer.
160*:						
San Joaquin-------	Severe: cemented pan.	Severe: shrink-swell.	Severe: cemented pan, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: droughty, thin layer.
Arents.						
Durochrepts.						
161---------------- Shanghai	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
162---------------- Shanghai	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
163---------------- Shanghai	Moderate: too clayey, wetness.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: low strength.	Slight.
164---------------- Shanghai	Moderate: too clayey, wetness, flooding.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
165, 166---------- Shanghai	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
167--------------- Shanghai	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
168--------------- Shanghai Variant	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: low strength, flooding, shrink-swell.	Slight.
169--------------- Snelling	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
170--------------- Snelling	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
171*, 172*:						
Stohlman---------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, thin layer.
Palls------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope.
173--------------- Subaco	Severe: cutbanks cave, wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
174--------------- Tisdale	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: thin layer.
175--------------- Yuvas	Severe: cemented pan.	Severe: flooding, shrink-swell.	Severe: flooding, cemented pan, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: thin layer.
176--------------- Yuvas	Severe: cemented pan, wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, cemented pan.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas 1/	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
101*, 102*:					
Altamont	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Dibble	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
103 Byington	Severe: wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
104 Capay	Severe: percs slowly.	Severe: flooding.	Severe: too clayey.	Moderate: flooding.	Poor: too clayey.
105, 106 Capay	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding.	Poor: too clayey.
107 Capay	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: depth to rock, too clayey.	Moderate: flooding, depth to rock.	Poor: too clayey.
108 Capay	Severe: percs slowly.	Severe: flooding.	Severe: wetness, too clayey.	Moderate: flooding, wetness.	Poor: too clayey.
109 Capay	Severe: percs slowly.	Severe: flooding.	Severe: cemented pan, too clayey.	Moderate: flooding, cemented pan.	Poor: too clayey, hard to pack.
110 Clear Lake	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
111 Clear Lake	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack.
112 Clear Lake	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
113 Clear Lake	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack.
114 Clear Lake	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: cemented pan, too clayey.	Moderate: flooding, cemented pan.	Poor: too clayey, hard to pack.
115 Clear Lake	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: depth to rock, too clayey.	Moderate: flooding, depth to rock.	Poor: too clayey, hard to pack.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas 1/	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
116----------------- Clear Lake	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, depth to rock, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
117----------------- Columbia	Severe: wetness.	Severe: seepage, flooding, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.
118----------------- Columbia	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
119----------------- Columbia	Severe: wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: wetness, too clayey.	Severe: seepage, wetness.	Poor: too clayey, hard to pack.
120----------------- Columbia	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, seepage, wetness.	Poor: too clayey, hard to pack.
121----------------- Columbia	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
122----------------- Columbia	Severe: wetness.	Severe: seepage, flooding, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: wetness.
123----------------- Cometa	Severe: percs slowly.	Slight-----------	Slight-----------	Slight-----------	Good.
124----------------- Conejo	Severe: percs slowly.	Moderate: seepage.	Slight-----------	Slight-----------	Good.
125----------------- Conejo	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Fair: area reclaim, too clayey, thin layer.
126*:					
Conejo-------------	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Fair: area reclaim, too clayey, thin layer.
Tisdale------------	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
127*:					
Conejo-------------	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Fair: area reclaim, too clayey, thin layer.
Urban land.					

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas 1/	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
128----------------- Exeter	Severe: cemented pan, percs slowly.	Severe: seepage, cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
129----------------- Galt	Severe: cemented pan, percs slowly.	Severe: flooding, cemented pan.	Severe: cemented pan, too clayey.	Severe: cemented pan.	Poor: area reclaim, too clayey, hard to pack.
130----------------- Galt	Severe: flooding, cemented pan, percs slowly.	Severe: flooding, cemented pan.	Severe: flooding, cemented pan, too clayey.	Severe: flooding, cemented pan.	Poor: cemented pan, too clayey, hard to pack.
131----------------- Garretson Variant	Moderate: percs slowly.	Moderate: seepage.	Slight-----------	Slight-----------	Good.
132----------------- Gridley	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
133----------------- Holillipah	Severe: poor filter.	Severe: seepage, flooding.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
134, 135------------ Holillipah	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: too sandy.
136----------------- Holillipah	Severe: poor filter.	Severe: seepage, flooding.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
137----------------- Jacktone	Severe: cemented pan, wetness, percs slowly.	Severe: flooding, cemented pan, wetness.	Severe: cemented pan, wetness, too clayey.	Severe: cemented pan.	Poor: area reclaim, too clayey, hard to pack.
138----------------- Liveoak	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Good.
139*:					
Liveoak Variant----	Severe: flooding.	Severe: flooding.	Severe: flooding, cemented pan, wetness.	Severe: flooding.	Fair: area reclaim, thin layer.
Galt Variant-------	Severe: flooding, depth to rock, cemented pan.	Severe: flooding, depth to rock, cemented pan.	Severe: flooding, depth to rock.	Severe: flooding, depth to rock, cemented pan.	Poor: area reclaim.
140----------------- Marcum	Severe: percs slowly.	Severe: flooding.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
141----------------- Marcum	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Poor: thin layer.
142----------------- Marcum	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas 1/	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
143*:					
Marcum	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Poor: thin layer.
Gridley	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
144 Nueva	Severe: percs slowly.	Severe: flooding.	Severe: wetness.	Moderate: flooding, wetness.	Good.
145 Nueva	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Good.
146 Nueva	Severe: percs slowly.	Severe: flooding.	Severe: wetness.	Moderate: flooding, wetness.	Good.
147, 148 Ocraig	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
149*:					
Ocraig	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Rock outcrop.					
150, 151 Olashes	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: thin layer.
152 Olashes	Severe: flooding, percs slowly.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: thin layer.
153 Oswald	Severe: depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
154 Oswald	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock.	Poor: area reclaim, too clayey, hard to pack.
155*:					
Palls	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
Bohna Variant	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
156*, 157*:					
Palls	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas 1/	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
156*, 157*:					
Stohlman	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
158 San Joaquin	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Severe: cemented pan, too clayey.	Severe: cemented pan.	Poor: area reclaim, too clayey.
159 San Joaquin	Severe: flooding, cemented pan, percs slowly.	Severe: flooding, cemented pan.	Severe: flooding, cemented pan, too clayey.	Severe: flooding, cemented pan.	Poor: area reclaim, too clayey.
160*:					
San Joaquin	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Severe: cemented pan, too clayey.	Severe: cemented pan.	Poor: area reclaim, too clayey.
Arents.					
Durochrepts.					
161 Shanghai	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
162 Shanghai	Severe: wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
163 Shanghai	Severe: percs slowly.	Severe: flooding.	Severe: wetness, too clayey.	Moderate: flooding, wetness.	Poor: too clayey, hard to pack.
164 Shanghai	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
165, 166 Shanghai	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
167 Shanghai	Severe: wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
168 Shanghai Variant	Severe: wetness, percs slowly.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
169 Snelling	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
170 Snelling	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
171*, 172*:					
Stohlman	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.

See footnotes at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas 1/	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
171*, 172*: Palls	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
173 Subaco	Severe: depth to rock, wetness, percs slowly.	Severe: flooding, depth to rock, wetness.	Severe: depth to rock, wetness, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
174 Tisdale	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
175 Yuvas	Severe: depth to rock, cemented pan.	Severe: flooding, depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Poor: area reclaim, too clayey, hard to pack.
176 Yuvas	Severe: flooding, depth to rock, cemented pan.	Severe: flooding, depth to rock, cemented pan.	Severe: flooding, depth to rock, cemented pan.	Severe: flooding, depth to rock, cemented pan.	Poor: area reclaim, too clayey, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

1/ If flood water will not enter or damage sewage lagoons (low velocity and depth less than 5 feet), disregard flooding.

TABLE 10.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
101*:				
Altamont	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Dibble	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
102*:				
Altamont	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Dibble	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
103 Byington	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
104, 105, 106, 107, 108, 109 Capay	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
110, 111 Clear Lake	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
112, 113, 114, 115, 116 Clear Lake	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
117, 118 Columbia	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
119, 120 Columbia	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
121, 122 Columbia	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
123 Cometa	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
124 Conejo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
125 Conejo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
126*:				
Conejo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
126*:				
Tisdale	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, thin layer.
127*:				
Conejo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land.				
128 Exeter	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
129, 130 Galt	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
131 Garretson Variant	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
132 Gridley	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
133, 134, 135, 136 Hollillipah	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
137 Jacktone	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
138 Liveoak	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
139*:				
Liveoak Variant	Fair: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Good.
Galt Variant	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey.
140, 141, 142 Marcum	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
143*:				
Marcum	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
Gridley	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
144, 145, 146 Nueva	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
147, 148: Ocraig	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
149*:				
Ocraig	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
150, 151, 152: Olashes	Good	Probable	Improbable: too sandy.	Good.
153, 154: Oswald	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
155*:				
Palls	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Bohna Variant	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
156*, 157*:				
Palls	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Stohlman	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
158, 159: San Joaquin	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
160*:				
San Joaquin	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Arents.				
Durochrepts.				
161, 162: Shanghai	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
163, 164: Shanghai	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
165, 166: Shanghai	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
167: Shanghai	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
168: Shanghai Variant	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
169, 170 Snelling	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
171*, 172*: Stohlman	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Palls	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
173 Subaco	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
174 Tisdale	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, thin layer.
175, 176 Yuvas	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
101*, 102*:						
Altamont	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, slope.	Slope, percs slowly.	Slope, percs slowly.
Dibble	Severe: slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
103 Byington	Moderate: seepage.	Severe: piping.	Favorable	Wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
104 Capay	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
105, 106 Capay	Slight	Moderate: hard to pack.	Deep to water 1/	Slow intake, percs slowly, flooding.	Percs slowly	Percs slowly.
107 Capay	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water 1/	Slow intake, percs slowly.	Percs slowly	Percs slowly.
108 Capay	Slight	Moderate: hard to pack.	Deep to water 1/	Slow intake, percs slowly.	Percs slowly	Percs slowly.
109 Capay	Moderate: cemented pan.	Moderate: thin layer, hard to pack.	Deep to water 1/	Slow intake, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
110 Clear Lake	Slight	Moderate: hard to pack, wetness.	Deep to water 1/	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
111 Clear Lake	Slight	Moderate: hard to pack, wetness.	Deep to water 1/	Percs slowly, erodes easily, flooding.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
112 Clear Lake	Slight	Moderate: hard to pack, wetness.	Deep to water 1/	Slow intake, percs slowly.	Percs slowly	Percs slowly.
113 Clear Lake	Slight	Moderate: hard to pack, wetness.	Deep to water 1/	Slow intake, percs slowly, flooding.	Percs slowly	Percs slowly.
114 Clear Lake	Moderate: cemented pan.	Moderate: thin layer, hard to pack.	Deep to water 1/	Slow intake, percs slowly.	Percs slowly	Percs slowly.
115 Clear Lake	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water 1/	Slow intake, percs slowly.	Percs slowly	Percs slowly.
116 Clear Lake	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water 1/	Slow intake, percs slowly, flooding.	Percs slowly	Percs slowly.
117 Columbia	Severe: seepage.	Severe: piping.	Deep to water 1/	Droughty	Favorable	Droughty.

See footnotes at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
118---------------- Columbia	Severe: seepage.	Severe: piping.	Deep to water 1/	Droughty, flooding.	Favorable------	Droughty.
119---------------- Columbia	Severe: seepage.	Moderate: hard to pack, wetness.	Deep to water 1/	Droughty, percs slowly.	Percs slowly---	Droughty.
120---------------- Columbia	Severe: seepage.	Moderate: hard to pack, wetness.	Deep to water 1/	Droughty, percs slowly, flooding.	Percs slowly---	Droughty.
121---------------- Columbia	Severe: seepage.	Severe: piping.	Deep to water 1/	Droughty, flooding.	Favorable------	Droughty.
122---------------- Columbia	Severe: seepage.	Severe: piping.	Deep to water 1/	Favorable------	Favorable------	Favorable.
123---------------- Cometa	Slight---------	Severe: piping.	Deep to water	Droughty, percs slowly.	Erodes easily	Erodes easily, percs slowly.
124---------------- Conejo	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
125---------------- Conejo	Moderate: depth to rock.	Moderate: thin layer, piping.	Deep to water	Favorable------	Favorable------	Favorable.
126*:						
Conejo------------	Moderate: depth to rock.	Moderate: thin layer, piping.	Deep to water	Favorable------	Favorable------	Favorable.
Tisdale-----------	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock	Depth to rock.
127*:						
Conejo------------	Moderate: depth to rock.	Moderate: thin layer, piping.	Deep to water	Favorable------	Favorable------	Favorable.
Urban land.						
128---------------- Exeter	Moderate: seepage, cemented pan.	Severe: thin layer.	Deep to water	Cemented pan---	Cemented pan, erodes easily.	Erodes easily, cemented pan.
129, 130----------- Galt	Moderate: cemented pan.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly, cemented pan.	Cemented pan, percs slowly.	Cemented pan, percs slowly.
131---------------- Garretson Variant	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
132---------------- Gridley	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
133, 134, 135------ Holillipah	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
136---------------- Holillipah	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty-------	Too sandy, soil blowing.	Droughty.

See footnotes at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
137 Jacktone	Moderate: cemented pan.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, cemented pan.	Wetness, slow intake, percs slowly.	Cemented pan, wetness, percs slowly.	Cemented pan, percs slowly.
138 Liveoak	Moderate: seepage.	Moderate: thin layer.	Deep to water	Favorable	Favorable	Favorable.
139*:						
Liveoak Variant	Moderate: seepage, cemented pan.	Severe: piping.	Deep to water 1/	Erodes easily, flooding.	Erodes easily	Erodes easily.
Galt Variant	Moderate: seepage, depth to rock, cemented pan.	Severe: thin layer.	Depth to rock, cemented pan, flooding.	Wetness, depth to rock, cemented pan.	Depth to rock, cemented pan, erodes easily.	Erodes easily, depth to rock, cemented pan.
140 Marcum	Slight	Slight	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
141 Marcum	Moderate: depth to rock.	Moderate: thin layer.	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
142 Marcum	Slight	Slight	Deep to water	Percs slowly, flooding.	Erodes easily	Erodes easily, percs slowly.
143*:						
Marcum	Moderate: depth to rock.	Moderate: thin layer.	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly.
Gridley	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
144 Nueva	Moderate: seepage.	Severe: piping.	Deep to water 1/	Erodes easily	Erodes easily	Erodes easily.
145 Nueva	Moderate: seepage.	Severe: piping.	Deep to water 1/	Erodes easily, flooding.	Erodes easily	Erodes easily.
146 Nueva	Moderate: seepage.	Severe: piping.	Deep to water 1/	Erodes easily	Erodes easily	Erodes easily.
147 Ocraig	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, depth to rock.	Slope, droughty, depth to rock.
148 Ocraig	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
149*:						
Ocraig	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
150 Olashes	Moderate: seepage.	Moderate: thin layer.	Deep to water	Favorable	Favorable	Favorable.
151 Olashes	Moderate: seepage, slope.	Moderate: thin layer.	Deep to water	Slope	Favorable	Favorable.

See footnotes at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
152 Olashes	Moderate: seepage.	Moderate: thin layer.	Deep to water	Flooding	Favorable	Favorable.
153 Oswald	Moderate: depth to rock.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, depth to rock.	Wetness, slow intake, percs slowly.	Depth to rock, wetness, percs slowly.	Depth to rock, percs slowly.
154 Oswald	Moderate: depth to rock.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, depth to rock, flooding.	Wetness, slow intake, percs slowly.	Depth to rock, wetness, percs slowly.	Depth to rock, percs slowly.
155*:						
Palls	Severe: seepage, slope.	Moderate: thin layer, seepage, piping.	Deep to water	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Bohna Variant	Severe: slope.	Slight	Deep to water	Slope	Slope	Slope.
156*, 157*:						
Palls	Severe: seepage, slope.	Moderate: thin layer, seepage, piping.	Deep to water	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Stohlman	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
158 San Joaquin	Moderate: cemented pan.	Severe: thin layer.	Deep to water	Droughty, percs slowly, cemented pan.	Cemented pan	Cemented pan.
159 San Joaquin	Moderate: cemented pan.	Severe: thin layer.	Deep to water	Droughty, percs slowly, cemented pan.	Cemented pan, percs slowly.	Cemented pan, percs slowly.
160*:						
San Joaquin	Moderate: cemented pan.	Severe: thin layer.	Deep to water	Droughty, percs slowly, cemented pan.	Cemented pan	Cemented pan.
Arents.						
Durochrepts.						
161 Shanghai	Moderate: seepage.	Moderate: piping, wetness.	Deep to water [1/]	Erodes easily, flooding.	Erodes easily	Erodes easily.
162 Shanghai	Moderate: seepage.	Moderate: piping, wetness.	Deep to water [1/]	Erodes easily	Erodes easily	Erodes easily.
163, 164 Shanghai	Moderate: seepage.	Moderate: hard to pack.	Deep to water [1/]	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
165 Shanghai	Moderate: seepage.	Moderate: piping, wetness.	Deep to water [1/]	Erodes easily, flooding.	Erodes easily	Erodes easily.

See footnotes at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
166: Shanghai	Moderate: seepage.	Moderate: piping, wetness.	Flooding	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Erodes easily.
167: Shanghai	Moderate: seepage.	Moderate: piping, wetness.	Deep to water 1/	Erodes easily	Erodes easily	Erodes easily.
168: Shanghai Variant	Slight	Severe: piping.	Deep to water 1/	Fast intake	Erodes easily	Erodes easily.
169: Snelling	Moderate: seepage.	Moderate: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
170: Snelling	Moderate: seepage.	Moderate: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
171*, 172*:						
Stohlman	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Palls	Severe: seepage, slope.	Moderate: thin layer, seepage, piping.	Deep to water	Droughty, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
173: Subaco	Moderate: depth to rock.	Severe: thin layer.	Percs slowly, depth to rock.	Wetness, slow intake, percs slowly.	Depth to rock, wetness, percs slowly.	Depth to rock, percs slowly.
174: Tisdale	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock	Depth to rock.
175: Yuvas	Moderate: depth to rock, cemented pan.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, cemented pan.	Depth to rock, cemented pan, percs slowly.	Depth to rock, cemented pan, percs slowly.
176: Yuvas	Moderate: depth to rock, cemented pan.	Severe: thin layer.	Percs slowly, depth to rock, cemented pan.	Wetness, percs slowly, depth to rock.	Depth to rock, cemented pan, wetness.	Depth to rock, cemented pan, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

1/ If irrigated, consider restrictive features for drainage.

TABLE 12.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
101*, 102*:											
Altamont	0-27	Silty clay	CH, CL	A-7	0	100	95-100	95-100	75-95	40-70	20-40
	27-52	Silty clay loam, silty clay, clay loam.	CH, CL	A-7	0	100	95-100	95-100	75-95	40-70	20-40
	52	Weathered bedrock	---	---	---	---	---	---	---	---	---
Dibble	0-5	Silty clay loam	CL	A-6	0	100	95-100	80-100	70-90	30-40	10-20
	5-22	Clay loam, clay, silty clay.	CH, CL	A-7	0	100	95-100	85-100	80-95	40-60	20-30
	22	Weathered bedrock	---	---	---	---	---	---	---	---	---
103 Byington	0-13	Silt loam	ML	A-4	0	100	100	90-100	80-90	25-40	NP-10
	13-60	Stratified silt loam to silty clay loam.	ML	A-4, A-6, A-7	0	100	100	90-100	85-95	25-45	NP-15
104, 105, 106 Capay	0-36	Silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-60	20-35
	36-60	Silty clay loam, clay loam.	CL	A-7	0	100	100	95-100	75-95	40-50	15-25
107 Capay	0-32	Silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-60	20-35
	32-50	Clay loam, silty clay loam.	CL	A-7	0	100	100	95-100	75-95	40-50	15-25
	50	Weathered bedrock	---	---	---	---	---	---	---	---	---
108 Capay	0-16	Silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-60	20-35
	16-60	Silty clay loam, clay loam.	CL	A-7	0	100	100	95-100	75-95	40-50	15-25
109 Capay	0-26	Clay	CH, CL	A-7	0	100	100	90-100	85-95	40-60	20-35
	26-42	Clay, silty clay	CH, CL	A-7	0	100	100	90-100	85-95	40-60	20-35
	42-46	Cemented	---	---	---	---	---	---	---	---	---
	46-60	Clay loam, loam	CL-ML, CL	A-4, A-6	0	90-100	85-100	80-90	50-75	25-40	5-20
110, 111 Clear Lake	0-15	Silt loam	CL-ML, ML	A-4	0	100	100	85-100	70-85	25-35	5-10
	15-60	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-70	20-40
112, 113 Clear Lake	0-42	Clay	CH, CL	A-7	0	100	100	95-100	85-95	40-70	20-40
	42-60	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-70	20-40
114 Clear Lake	0-14	Clay	CL, CH	A-7	0	100	100	90-100	80-95	40-60	20-35
	14-35	Clay, silty clay	CL, CH	A-6, A-7	0	100	100	90-100	80-95	35-55	15-30
	35-48	Clay loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	75-95	65-85	25-45	5-20
	48-60	Cemented	---	---	---	---	---	---	---	---	---
115, 116 Clear Lake	0-42	Clay	CH, CL	A-7	0	100	100	95-100	85-95	40-70	20-40
	42-48	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-70	20-40
	48	Weathered bedrock	---	---	---	---	---	---	---	---	---
117, 118 Columbia	0-14	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	95-100	65-90	30-50	20-30	NP-10
	14-60	Fine sandy loam, very fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	65-90	30-50	20-30	NP-10
119, 120 Columbia	0-15	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	95-100	65-90	30-50	20-30	NP-10
	15-52	Stratified sand to silt loam.	SM	A-4	0	100	95-100	60-90	35-50	20-25	NP-5
	52-60	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	100	95-100	90-100	75-95	40-60	20-35

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
121-------------- Columbia	0-14	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	95-100	65-90	30-50	20-30	NP-10
	14-60	Fine sandy loam, very fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	65-90	30-50	20-30	NP-10
122-------------- Columbia	0-25	Loam-------------	CL-ML	A-4	0	100	95-100	80-90	50-60	20-30	5-10
	25-60	Stratified sand to silt loam.	SM	A-4	0	100	95-100	60-90	35-50	20-25	NP-5
123-------------- Cometa	0-16	Loam-------------	CL-ML, ML	A-4	0	95-100	90-100	75-90	50-70	25-35	5-10
	16-60	Sandy clay, clay, clay loam.	CL, CH	A-7	0	95-100	95-100	70-95	50-80	40-60	20-35
124-------------- Conejo	0-30	Loam-------------	CL-ML, ML	A-4	0	95-100	90-100	70-85	50-65	25-35	5-10
	30-60	Loam-------------	CL, CL-ML	A-6, A-4	0	95-100	90-100	70-85	50-65	25-40	5-15
125-------------- Conejo	0-11	Loam-------------	ML, CL-ML	A-4	0	100	100	85-95	60-75	25-35	5-10
	11-42	Loam, clay loam	CL	A-6	0	100	100	85-100	60-80	25-40	10-20
	42	Weathered bedrock	---	---	---	---	---	---	---	---	---
126*:											
Conejo-----------	0-11	Loam-------------	ML, CL-ML	A-4	0	100	100	85-95	60-75	25-35	5-10
	11-42	Loam, clay loam	CL	A-6	0	100	100	85-100	60-80	25-40	10-20
	42	Weathered bedrock	---	---	---	---	---	---	---	---	---
Tisdale----------	0-11	Clay loam--------	CL	A-6	0	100	100	90-100	70-80	30-40	10-15
	11-31	Loam, clay loam	CL	A-6	0	100	100	85-100	60-80	25-40	10-20
	31	Weathered bedrock	---	---	---	---	---	---	---	---	---
127*:											
Conejo-----------	0-11	Loam-------------	ML, CL-ML	A-4	0	100	100	85-95	60-75	25-35	5-10
	11-42	Loam, clay loam	CL	A-6	0	100	100	85-100	60-80	25-40	10-20
	42	Weathered bedrock	---	---	---	---	---	---	---	---	---
Urban land.											
128-------------- Exeter	0-9	Sandy loam-------	SM, SM-SC	A-4	0	95-100	85-100	50-70	35-50	15-25	NP-10
	9-30	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	95-100	85-100	70-90	35-65	25-40	10-20
	30-50	Indurated--------	---	---	---	---	---	---	---	---	---
	50-60	Stratified sandy loam to silt loam.	SM, ML	A-4	0	80-100	75-85	60-85	35-60	20-35	NP-10
129, 130--------- Galt	0-10	Clay-------------	CL, CH	A-7	0	100	100	90-100	75-95	45-65	20-40
	10-21	Clay, silty clay	CL, CH	A-7	0	100	100	90-100	75-95	45-65	20-40
	21-42	Cemented---------	---	---	---	---	---	---	---	---	---
	42-62	Loam-------------	CL-ML, ML	A-4	0	95-100	90-100	70-85	50-60	25-35	5-10
131-------------- Garretson Variant	0-15	Loam-------------	CL-ML, ML	A-4	0	100	100	85-95	60-75	25-35	5-10
	15-46	Loam-------------	CL-ML, ML	A-4	0	100	100	85-95	60-75	25-35	5-10
	46-60	Loam, very fine sandy loam, fine sandy loam.	CL-ML, ML, SM-SC, SM	A-4	0	100	100	80-95	40-70	25-35	5-10
132-------------- Gridley	0-19	Clay loam--------	CL	A-6	0	100	100	90-100	70-85	30-40	10-20
	19-37	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	100	90-100	70-95	40-60	20-35
	37	Weathered bedrock	---	---	---	---	---	---	---	---	---
133, 134, 135---- Hollillipah	0-8	Loamy sand-------	SM	A-2	0	90-100	85-100	60-75	20-30	---	NP
	8-60	Stratified sand to loamy fine sand.	SM	A-1, A-2	0	80-100	75-100	35-75	10-30	---	NP

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
136------------- Holillipah	0-15	Sandy loam-------	SM	A-4	0	95-100	85-100	60-75	35-50	20-30	NP-5
	15-60	Stratified sand to loamy fine sand.	SM	A-1, A-2	0	80-100	75-100	35-75	10-30	---	NP
137------------- Jacktone	0-25	Clay------------	CL, CH	A-7	0	100	100	90-100	80-95	40-60	20-35
	25-35	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	100	85-100	80-95	40-60	20-35
	35-39	Indurated--------	---	---	---	---	---	---	---	---	---
	39-60	Cemented---------	---	---	---	---	---	---	---	---	---
138------------- Liveoak	0-13	Sandy clay loam	SM-SC, SM	A-4	0	100	100	70-85	35-50	25-35	5-10
	13-53	Sandy clay loam	SM-SC, SC	A-4, A-6	0	100	100	70-85	35-50	25-35	5-15
	53-60	Sandy loam, loamy sand.	SM	A-2	0	100	100	55-65	20-35	20-30	NP-5
139*:											
Liveoak Variant-	0-6	Loam------------	CL-ML, ML	A-4	0	100	100	85-95	60-75	25-35	5-10
	6-54	Loam------------	CL-ML, ML	A-4	0	100	100	85-95	60-75	25-35	5-10
	54-63	Indurated--------	---	---	---	---	---	---	---	---	---
	63-73	Very fine sandy loam.	ML	A-4	0	100	100	85-95	50-65	25-35	NP-10
Galt Variant----	0-21	Clay loam--------	CL	A-6	0	100	100	90-100	70-85	30-40	10-20
	21-22	Indurated--------	---	---	---	---	---	---	---	---	---
	22-25	Loam------------	ML	A-4	0	100	100	85-95	60-75	25-35	NP-10
	25-26	Indurated--------	---	---	---	---	---	---	---	---	---
	26	Weathered bedrock	---	---	---	---	---	---	---	---	---
140------------- Marcum	0-9	Clay loam--------	CL	A-6	0	100	100	90-100	70-85	30-40	10-20
	9-35	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	75-95	45-65	20-35
	35-60	Clay loam--------	CL	A-6, A-7	0	100	100	90-100	70-90	35-50	15-25
141------------- Marcum	0-16	Clay loam--------	CL	A-6	0	100	100	90-100	70-85	30-40	10-20
	16-28	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	90-100	70-90	35-50	15-25
	28-40	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	75-95	45-65	20-35
	40-43	Clay loam--------	CL	A-6, A-7	0	100	100	90-100	70-90	35-50	15-25
	43	Weathered bedrock	---	---	---	---	---	---	---	---	---
142------------- Marcum	0-9	Clay loam--------	CL	A-6	0	100	100	90-100	70-85	30-40	10-20
	9-35	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	75-95	45-65	20-35
	35-60	Clay loam--------	CL	A-6, A-7	0	100	100	90-100	70-90	35-50	15-25
143*:											
Marcum----------	0-16	Clay loam--------	CL	A-6	0	100	100	90-100	70-85	30-40	10-20
	16-28	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	90-100	70-90	35-50	15-25
	28-40	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	75-95	45-65	20-35
	40-43	Clay loam--------	CL	A-6, A-7	0	100	100	90-100	70-90	35-50	15-25
	43	Weathered bedrock	---	---	---	---	---	---	---	---	---
Gridley---------	0-19	Clay loam--------	CL	A-6	0	100	100	90-100	70-85	30-40	10-20
	19-37	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	100	90-100	70-95	40-60	20-35
	37	Weathered bedrock	---	---	---	---	---	---	---	---	---
144------------- Nueva	0-17	Loam------------	CL-ML, ML	A-4	0	100	100	85-95	50-75	25-35	5-10
	17-42	Stratified sandy loam to silt loam.	CL-ML, ML	A-4	0	100	100	70-90	50-70	25-35	5-10
	42-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	80-90	30-40	10-20

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
145 Nueva	0-22	Loam	CL-ML, ML	A-4	0	100	100	85-95	50-75	25-35	5-10
	22-60	Stratified sandy loam to silt loam.	CL-ML, ML	A-4	0	100	100	70-90	50-70	25-35	5-10
146 Nueva	0-17	Loam	CL-ML	A-4	0	100	100	85-95	65-75	25-30	5-10
	17-42	Stratified silt loam to sandy loam.	CL-ML, ML	A-4	0	100	100	70-90	50-70	25-35	5-10
	42-60	Clay loam, silty clay loam.	CL	A-6	0	100	100	90-100	80-90	30-40	10-20
147 Ocraig	0-2	Gravelly coarse sandy loam.	SM, GM	A-1, A-2	0-10	60-80	55-75	35-50	20-35	20-30	NP-5
	2-8	Gravelly coarse sandy loam, gravelly sandy loam.	SM, GM	A-1, A-2	0-10	60-80	55-75	35-50	20-35	20-30	NP-5
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
148 Ocraig	0-2	Very stony coarse sandy loam.	SM	A-1, A-2	15-25	70-85	65-80	40-55	20-35	20-30	NP-5
	2-8	Very stony sandy loam, very stony coarse sandy loam.	SM	A-1, A-2	15-25	70-85	65-80	40-55	20-35	20-30	NP-5
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
149*:											
Ocraig	0-2	Very stony coarse sandy loam.	SM	A-1, A-2	15-25	70-85	65-80	40-55	20-35	20-30	NP-5
	2-8	Very stony sandy loam, very stony coarse sandy loam.	SM	A-1, A-2	15-25	70-85	65-80	40-55	20-35	20-30	NP-5
	8	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
150, 151, 152 Olashes	0-4	Sandy loam	SM, SM-SC	A-4	0	85-100	80-100	50-70	35-50	20-30	NP-10
	4-52	Sandy clay loam	SC	A-6	0	85-100	80-100	70-90	35-50	30-40	10-15
	52-60	Sand	SP-SM, SM	A-1	0	85-100	80-100	35-50	5-15	---	NP
153, 154 Oswald	0-15	Clay	CH, CL	A-7	0	100	100	95-100	85-95	45-65	20-35
	15-33	Silty clay, clay	CH, CL	A-7	0	100	100	95-100	85-95	45-65	20-35
	33	Weathered bedrock	---	---	---	---	---	---	---	---	---
155*:											
Palls	0-8	Stony sandy loam	SM	A-2	10-25	65-90	60-85	40-60	25-35	20-25	NP-5
	8-31	Gravelly sandy loam.	SM-SC, SM	A-2	5-20	65-80	60-75	40-50	25-30	20-30	NP-10
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Bohna Variant	0-7	Sandy loam	SM-SC, SM	A-4	0	95-100	90-100	60-70	35-50	20-30	NP-10
	7-60	Sandy clay loam	SC	A-6	0	95-100	90-100	75-85	35-50	30-40	10-20
156*, 157*:											
Palls	0-8	Stony sandy loam	SM	A-2	10-25	65-90	60-85	40-60	25-35	20-25	NP-5
	8-31	Gravelly sandy loam.	SM-SC, SM	A-2	5-20	65-80	60-75	40-50	25-30	20-30	NP-10
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
156*, 157*:											
Stohlman--------	0-7	Stony sandy loam	SM	A-2	10-25	65-90	60-85	40-60	25-35	20-25	NP-5
	7-16	Gravelly sandy loam, cobbly sandy loam.	SM-SC, SM	A-2	10-20	65-90	60-85	40-60	25-35	20-30	NP-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
158, 159--------- San Joaquin	0-16	Sandy loam-------	SM	A-4	0	95-100	90-100	65-85	35-50	15-25	NP-5
	16-27	Clay loam, clay	CL	A-7	0	95-100	95-100	80-95	55-70	40-50	25-35
	27-31	Indurated--------	---	---	---	---	---	---	---	---	---
	31-60	Stratified sandy loam to loam.	SM, SM-SC	A-2, A-4	0	90-100	85-100	60-75	30-50	10-25	NP-10
160*:											
San Joaquin-----	0-16	Sandy loam-------	SM	A-4	0	95-100	90-100	65-85	35-50	15-25	NP-5
	16-27	Clay loam, clay	CL	A-7	0	95-100	95-100	80-95	55-70	40-50	25-35
	27-31	Indurated--------	---	---	---	---	---	---	---	---	---
	31-60	Stratified sandy loam to loam.	SM, SM-SC	A-2, A-4	0	90-100	85-100	60-75	30-50	10-25	NP-10
Arents.											
Durochrepts.											
161-------------- Shanghai	0-15	Fine sandy loam	ML, SM	A-4	0	100	100	80-95	40-55	20-30	NP-5
	15-60	Stratified silty clay loam to fine sandy loam.	ML	A-6, A-7	0	100	100	90-100	85-95	35-45	10-15
162-------------- Shanghai	0-9	Silt loam--------	ML	A-4	0	100	100	90-100	75-90	30-40	5-10
	9-60	Stratified silty clay loam to fine sandy loam.	ML	A-6, A-7	0	100	100	90-100	85-95	35-45	10-15
163, 164--------- Shanghai	0-12	Silt loam--------	ML	A-4	0	100	100	90-100	75-90	30-40	5-10
	12-41	Stratified silty clay loam to fine sandy loam.	ML	A-6, A-7	0	100	100	90-100	85-95	35-45	10-15
	41-60	Clay-------------	CH, CL	A-7	0	100	100	95-100	85-95	45-65	20-40
165-------------- Shanghai	0-11	Silt loam--------	ML	A-4	0	100	100	90-100	75-90	30-40	5-10
	11-60	Stratified silty clay loam to fine sandy loam.	ML	A-6, A-7	0	100	100	90-100	85-95	35-45	10-15
166-------------- Shanghai	0-8	Silt loam--------	ML	A-4	0	100	100	90-100	75-90	30-40	5-10
	8-60	Stratified silty clay loam to fine sandy loam.	ML	A-6, A-7	0	100	100	90-100	85-95	35-45	10-15
167-------------- Shanghai	0-38	Silty clay loam	ML	A-6, A-7	0	100	100	95-100	85-95	35-45	10-15
	38-60	Stratified silty clay loam to fine sandy loam.	ML	A-6, A-7	0	100	100	90-100	85-95	35-45	10-15
168-------------- Shanghai Variant	0-18	Loamy sand-------	SM	A-2	0	100	100	50-75	15-30	---	NP
	18-60	Stratified silt loam to silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	95-100	75-85	25-40	5-15
169, 170--------- Snelling	0-19	Loam-------------	CL-ML, ML	A-4	0	90-100	75-100	60-80	50-60	25-35	5-10
	19-51	Clay loam, sandy clay loam, loam.	CL, SC	A-6	0	90-100	85-100	70-90	45-60	25-40	10-20
	51-60	Sandy loam, loamy sand.	SM	A-2	0	90-100	75-100	40-65	25-35	20-30	NP-5

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
171*, 172*:											
Stohlman---------	0-7	Stony sandy loam	SM	A-2	10-25	65-90	60-85	40-60	25-35	20-25	NP-5
	7-16	Gravelly sandy loam, cobbly sandy loam.	SM-SC, SM	A-2	10-20	65-90	60-85	40-60	25-35	20-30	NP-10
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Palls------------	0-8	Stony sandy loam	SM	A-2	10-25	65-90	60-85	40-60	25-35	20-25	NP-5
	8-31	Gravelly sandy loam.	SM-SC, SM	A-2	5-20	65-80	60-75	40-50	25-30	20-30	NP-10
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
173-------------- Subaco	0-13	Clay--------------	CH	A-7	0	100	100	90-100	75-95	50-70	25-40
	13-26	Clay--------------	CH	A-7	0	100	100	90-100	75-95	50-70	25-40
	26	Weathered bedrock	---	---	---	---	---	---	---	---	---
174-------------- Tisdale	0-11	Clay loam---------	CL	A-6	0	100	100	90-100	70-80	30-40	10-15
	11-31	Loam, clay loam	CL	A-6	0	100	100	85-100	60-80	25-40	10-20
	31	Weathered bedrock	---	---	---	---	---	---	---	---	---
175, 176---------- Yuvas	0-16	Loam--------------	CL-ML, ML	A-4	0	100	100	85-95	50-70	25-35	5-10
	16-24	Clay--------------	CL, CH	A-7	0	100	100	90-100	75-95	40-60	20-35
	24-38	Indurated---------	---	---	---	---	---	---	---	---	---
	38	Weathered bedrock	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
101*, 102*: Altamont	0-27	35-60	0.06-0.2	0.12-0.16	6.6-8.4	<2	High	0.24	3	1-3
	27-52	35-60	0.06-0.2	0.12-0.16	7.4-8.4	<2	High	0.24		
	52	---	---	---	---	---	---	---		
Dibble	0-5	27-30	0.2-0.6	0.16-0.19	5.6-6.5	<2	Moderate	0.37	2	.5-1
	5-22	35-45	0.06-0.2	0.14-0.18	6.1-7.3	<2	High	0.32		
	22	---	---	---	---	---	---	---		
103 Byington	0-13	18-27	0.6-2.0	0.16-0.18	>7.8	<4	Low	0.43	5	1-3
	13-60	18-30	0.6-2.0	0.15-0.19	>7.8	<4	Low	0.43		
104, 105, 106 Capay	0-36	40-60	0.06-0.2	0.14-0.16	6.6-8.4	<2	High	0.24	5	1-2
	36-60	35-40	0.06-0.2	0.17-0.19	7.9-8.4	<2	High	0.28		
107 Capay	0-32	40-60	0.06-0.2	0.14-0.16	7.9-8.4	<2	High	0.24	5	1-2
	32-50	35-40	0.06-0.2	0.17-0.19	7.9-8.4	<2	High	0.28		
	50	---	---	---	---	---	---	---		
108 Capay	0-16	40-60	0.06-0.2	0.13-0.16	6.6-8.4	<4	High	0.24	5	1-2
	16-60	35-40	0.06-0.2	0.16-0.19	7.9-8.4	<4	High	0.28		
109 Capay	0-26	40-60	0.06-0.2	0.14-0.16	6.6-7.3	<2	High	0.24	3	1-2
	26-42	40-60	0.06-0.2	0.14-0.16	6.6-8.4	<2	High	0.28		
	42-46	---	---	---	---	---	---	---		
	46-60	20-35	0.2-0.6	0.14-0.17	7.4-8.4	<2	Moderate	0.37		
110, 111 Clear Lake	0-15	15-25	0.6-2.0	0.17-0.19	6.6-7.3	<2	Low	0.43	5	1-2
	15-60	40-60	0.06-0.2	0.12-0.16	7.9-8.4	<4	High	0.24		
112, 113 Clear Lake	0-42	40-60	0.06-0.2	0.12-0.16	6.6-8.4	<2	High	0.24	5	1-4
	42-60	40-60	0.06-0.2	0.12-0.16	7.4-8.4	<4	High	0.24		
114 Clear Lake	0-14	40-55	0.06-0.2	0.14-0.16	6.1-7.8	<2	High	0.24	3	2-5
	14-35	40-55	0.06-0.2	0.14-0.16	7.4-8.4	<2	High	0.24		
	35-48	25-40	0.06-0.2	0.14-0.17	7.9-8.4	<2	Moderate	0.32		
	48-60	---	---	---	---	---	---	---		
115, 116 Clear Lake	0-42	40-60	0.06-0.2	0.14-0.16	6.6-7.8	<2	High	0.24	3	1-4
	42-48	40-60	0.06-0.2	0.14-0.16	7.4-8.4	<2	High	0.24		
	48	---	---	---	---	---	---	---		
117, 118 Columbia	0-14	8-18	2.0-6.0	0.10-0.12	6.6-7.8	<2	Low	0.32	5	.5-2
	14-60	10-18	2.0-6.0	0.10-0.12	6.6-7.8	<2	Low	0.32		
119, 120 Columbia	0-15	8-18	2.0-6.0	0.10-0.12	6.6-7.8	<2	Low	0.32	5	.5-2
	15-52	10-18	2.0-6.0	0.08-0.11	6.6-7.8	<2	Low	0.32		
	52-60	35-60	0.06-0.2	0.14-0.16	6.6-7.8	<2	High	0.28		
121 Columbia	0-14	8-18	2.0-6.0	0.10-0.12	6.6-7.8	<2	Low	0.32	5	.5-2
	14-60	10-18	2.0-6.0	0.10-0.12	6.6-7.8	<2	Low	0.32		
122 Columbia	0-25	10-18	0.6-2.0	0.14-0.16	6.6-7.8	<2	Low	0.32	5	.5-2
	25-60	10-18	2.0-6.0	0.08-0.11	6.6-7.8	<2	Low	0.32		
123 Cometa	0-16	15-25	0.6-2.0	0.14-0.16	5.6-6.5	<2	Low	0.37	2	.5-1
	16-60	35-50	<0.06	0.04-0.06	6.1-7.3	<2	High	0.24		
124 Conejo	0-30	20-27	0.6-2.0	0.15-0.17	6.6-7.8	<2	Low	0.32	5	1-4
	30-60	20-27	0.6-2.0	0.14-0.16	7.4-8.4	<2	Moderate	0.37		

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
125---------------Conejo	0-11	20-27	0.6-2.0	0.15-0.17	6.6-7.8	<2	Low------------	0.32	3	1-4
	11-42	20-35	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate------	0.28		
	42	---	---	---	---	---	---------------	----		
126*:										
Conejo-----------	0-11	20-27	0.6-2.0	0.15-0.17	6.6-7.8	<2	Low------------	0.32	3	1-4
	11-42	20-35	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate------	0.28		
	42	---	---	---	---	---	---------------	----		
Tisdale----------	0-11	27-30	0.2-0.6	0.17-0.19	6.6-7.8	<2	Moderate------	0.28	2	1-3
	11-31	21-35	0.2-0.6	0.14-0.19	6.6-8.4	<2	Moderate------	0.28		
	31	---	---	---	---	---	---------------	----		
127*:										
Conejo-----------	0-11	20-27	0.6-2.0	0.15-0.17	6.6-7.8	<2	Low------------	0.32	3	1-4
	11-42	20-35	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate------	0.28		
	42	---	---	---	---	---	---------------	----		
Urban land.										
128---------------Exeter	0-9	10-20	0.6-2.0	0.10-0.13	6.6-7.3	<2	Low------------	0.28	2	<1
	9-30	18-30	0.6-2.0	0.14-0.17	6.6-7.8	<2	Moderate------	0.37		
	30-50	---	---	---	---	---	---------------	----		
	50-60	5-15	0.2-0.6	0.09-0.15	7.4-8.4	<2	Low------------	0.28		
129, 130----------Galt	0-10	40-60	0.06-0.2	0.12-0.15	6.1-7.3	<2	High-----------	0.24	2	1-2
	10-21	40-60	0.06-0.2	0.12-0.14	6.6-8.4	<2	High-----------	0.24		
	21-42	---	---	---	---	---	---------------	----		
	42-62	20-27	0.6-2.0	0.15-0.17	7.4-8.4	<2	Low------------	0.32		
131---------------Garretson Variant	0-15	20-27	0.6-2.0	0.14-0.18	7.9-8.4	<2	Low------------	0.32	5	<1
	15-46	20-27	0.6-2.0	0.14-0.18	7.9-8.4	<2	Low------------	0.32		
	46-60	15-27	0.6-2.0	0.12-0.16	7.9-8.4	<2	Low------------	0.32		
132---------------Gridley	0-19	27-35	0.2-0.6	0.17-0.20	6.6-8.4	<2	Moderate------	0.32	2	1-3
	19-37	35-55	0.06-0.2	0.14-0.17	6.6-8.4	<2	High-----------	0.28		
	37	---	---	---	---	---	---------------	----		
133, 134, 135-----Holillipah	0-8	0-10	6.0-20	0.06-0.08	6.1-7.3	<2	Low------------	0.17	5	1-2
	8-60	0-10	6.0-20	0.06-0.09	6.1-7.3	<2	Low------------	0.17		
136---------------Holillipah	0-15	5-15	2.0-6.0	0.10-0.13	6.1-7.3	<2	Low------------	0.20	5	1-2
	15-60	0-10	6.0-20	0.06-0.09	6.1-7.3	<2	Low------------	0.17		
137---------------Jacktone	0-25	40-60	0.06-0.2	0.14-0.16	6.6-8.4	<2	High-----------	0.24	2	2-5
	25-35	35-60	0.06-0.2	0.14-0.16	7.4-8.4	<2	High-----------	0.24		
	35-39	---	---	---	---	---	---------------	----		
	39-60	---	---	---	---	---	---------------	----		
138---------------Liveoak	0-13	20-25	0.6-2.0	0.14-0.16	6.1-7.8	<2	Low------------	0.20	5	1-3
	13-53	20-25	0.6-2.0	0.14-0.16	6.6-8.4	<2	Moderate------	0.28		
	53-60	5-15	2.0-6.0	0.08-0.11	7.4-8.4	<2	Low------------	0.28		
139*:										
Liveoak Variant-	0-6	18-25	0.6-2.0	0.15-0.17	7.4-8.4	<2	Low------------	0.37	3	<1
	6-54	18-25	0.6-2.0	0.15-0.17	7.4-8.4	<2	Low------------	0.37		
	54-63	---	---	---	---	---	---------------	----		
	63-73	10-18	0.6-2.0	0.13-0.15	6.6-7.3	<2	Low------------	0.37		
Galt Variant-----	0-21	27-35	0.2-0.6	0.18-0.20	6.6-8.4	<2	Moderate------	0.32	2	<1
	21-22	---	---	---	---	<2	---------------	----		
	22-25	10-20	0.6-2.0	0.14-0.16	6.6-8.4	<2	Low------------	0.37		
	25-26	---	---	---	---	---	---------------	----		
	26	---	---	---	---	---	---------------	----		

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
140-------------- Marcum	0-9	27-35	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.32	3	1-2
	9-35	40-60	0.06-0.2	0.14-0.16	6.6-8.4	<2	High----------	0.28		
	35-60	30-40	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.32		
141-------------- Marcum	0-16	27-35	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.32	3	1-2
	16-28	30-40	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.37		
	28-40	40-60	0.06-0.2	0.14-0.16	6.6-8.4	<2	High----------	0.28		
	40-43	30-40	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.32		
	43	---	---	---	---	---	--------------	----		
142-------------- Marcum	0-9	27-35	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.32	3	1-2
	9-35	40-60	0.06-0.2	0.14-0.16	6.6-8.4	<2	High----------	0.28		
	35-60	30-40	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.32		
143*:										
Marcum----------	0-16	27-35	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.32	3	1-2
	16-28	30-40	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.37		
	28-40	40-60	0.06-0.2	0.14-0.16	6.6-8.4	<2	High----------	0.28		
	40-43	30-40	0.2-0.6	0.17-0.19	6.6-8.4	<2	Moderate------	0.32		
	43	---	---	---	---	---	--------------	----		
Gridley---------	0-19	27-35	0.2-0.6	0.17-0.20	6.6-8.4	<2	Moderate------	0.32	2	1-3
	19-37	35-55	0.06-0.2	0.14-0.17	6.6-8.4	<2	High----------	0.28		
	37	---	---	---	---	---	--------------	----		
144-------------- Nueva	0-17	18-27	0.6-2.0	0.15-0.17	6.6-7.8	<2	Low-----------	0.37	5	1-3
	17-42	15-27	0.6-2.0	0.14-0.16	7.4-8.4	<2	Low-----------	0.37		
	42-60	27-35	0.2-0.6	0.17-0.20	7.9-8.4	<2	Moderate------	0.37		
145-------------- Nueva	0-22	18-27	0.6-2.0	0.15-0.17	6.6-7.8	<2	Low-----------	0.37	5	1-3
	22-60	15-27	0.6-2.0	0.14-0.16	7.4-8.4	<2	Low-----------	0.37		
146-------------- Nueva	0-17	18-27	0.6-2.0	0.14-0.17	6.6-7.8	<2	Low-----------	0.37	5	1-3
	17-42	15-27	0.6-2.0	0.13-0.16	7.4-8.4	<2	Low-----------	0.37		
	42-60	27-35	0.2-0.6	0.17-0.20	7.9-8.4	<2	Moderate------	0.32		
147-------------- Ocraig	0-2	5-15	2.0-6.0	0.07-0.11	6.6-7.3	<2	Low-----------	0.20	1	1-3
	2-8	5-15	2.0-6.0	0.07-0.11	6.6-7.3	<2	Low-----------	0.20		
	8	---	---	---	---	---	--------------	----		
148-------------- Ocraig	0-2	5-15	2.0-6.0	0.06-0.10	6.6-7.3	<2	Low-----------	0.15	1	1-3
	2-8	5-15	2.0-6.0	0.06-0.10	6.6-7.3	<2	Low-----------	0.15		
	8	---	---	---	---	---	--------------	----		
149*:										
Ocraig----------	0-2	5-15	2.0-6.0	0.06-0.10	6.6-7.3	<2	Low-----------	0.15	1	1-3
	2-8	5-15	2.0-6.0	0.06-0.10	6.6-7.3	<2	Low-----------	0.15		
	8	---	---	---	---	---	--------------	----		
Rock outcrop.										
150, 151, 152---- Olashes	0-4	15-20	2.0-6.0	0.09-0.12	6.1-7.3	<2	Low-----------	0.28	5	1-3
	4-52	20-35	0.2-0.6	0.13-0.16	6.6-7.8	<2	Moderate------	0.32		
	52-60	5-10	6.0-20	0.04-0.07	7.4-7.8	<2	Low-----------	0.20		
153, 154--------- Oswald	0-15	40-60	0.06-0.2	0.14-0.17	6.6-8.4	<2	High----------	0.24	2	1-3
	15-33	40-60	0.06-0.2	0.14-0.17	7.9-8.4	<2	High----------	0.24		
	33	---	---	---	---	---	--------------	----		
155*:										
Palls-----------	0-8	5-15	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.17	2	1-3
	8-31	10-18	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.20		
	31	---	---	---	---	---	--------------	----		
Bohna Variant---	0-7	15-20	2.0-6.0	0.10-0.13	6.1-6.5	<2	Low-----------	0.32	5	1-2
	7-60	20-35	0.2-0.6	0.15-0.17	6.1-6.5	<2	Moderate------	0.32		

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
156*, 157*:										
Palls-----------	0-8	5-15	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.17	2	1-3
	8-31	10-18	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.20		
	31	---	---	---	---	---	-------------	----		
Stohlman--------	0-7	5-15	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.17	1	1-3
	7-16	10-18	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.20		
	16	---	---	---	---	---	-------------	----		
158, 159--------- San Joaquin	0-16	10-20	0.6-2.0	0.10-0.13	5.6-6.5	<2	Low-----------	0.32	2	.5-1
	16-27	35-45	<0.06	0.04-0.06	5.6-7.8	<2	High----------	0.24		
	27-31	---	---	---	---	---	-------------	----		
	31-60	10-25	0.06-0.2	0.10-0.12	6.1-7.8	<2	Low-----------	0.32		
160*:										
San Joaquin-----	0-16	10-20	0.6-2.0	0.10-0.13	5.6-6.5	<2	Low-----------	0.32	2	.5-1
	16-27	35-45	<0.06	0.04-0.06	5.6-7.8	<2	High----------	0.24		
	27-31	---	---	---	---	---	-------------	----		
	31-60	10-25	0.06-0.2	0.10-0.12	6.1-7.8	<2	Low-----------	0.32		
Arents.										
Durochrepts.										
161-------------- Shanghai	0-15	10-20	0.6-2.0	0.12-0.14	6.6-8.4	<2	Low-----------	0.37	5	1-2
	15-60	20-35	0.6-2.0	0.15-0.19	6.6-8.4	<2	Moderate------	0.43		
162-------------- Shanghai	0-9	20-27	0.6-2.0	0.15-0.19	6.6-8.4	<2	Low-----------	0.49	5	1-2
	9-60	20-35	0.6-2.0	0.15-0.19	6.6-8.4	<2	Moderate------	0.43		
163, 164--------- Shanghai	0-12	20-27	0.6-2.0	0.15-0.19	6.6-8.4	<2	Low-----------	0.49	5	1-2
	12-41	20-35	0.6-2.0	0.15-0.19	6.6-8.4	<2	Moderate------	0.43		
	41-60	40-60	0.06-0.2	0.14-0.16	6.6-8.4	<2	High----------	0.24		
165-------------- Shanghai	0-11	20-27	0.6-2.0	0.15-0.19	6.6-8.4	<2	Low-----------	0.49	5	1-2
	11-60	20-35	0.6-2.0	0.15-0.19	6.6-8.4	<2	Moderate------	0.43		
166-------------- Shanghai	0-8	20-27	0.6-2.0	0.15-0.19	6.6-8.4	<2	Low-----------	0.49	5	1-2
	8-60	20-35	0.6-2.0	0.15-0.19	6.6-8.4	<2	Moderate------	0.43		
167-------------- Shanghai	0-38	27-35	0.2-0.6	0.17-0.20	6.6-8.4	<2	Moderate------	0.43	5	1-2
	38-60	20-35	0.6-2.0	0.15-0.19	6.6-8.4	<2	Moderate------	0.43		
168-------------- Shanghai Variant	0-18	4-10	6.0-20	0.06-0.08	6.6-7.3	<2	Low-----------	0.15	5	<1
	18-60	18-35	0.2-0.6	0.2-6.0	7.4-8.4	<2	Moderate------	0.37		
169, 170--------- Snelling	0-19	10-25	0.6-2.0	0.13-0.16	6.1-7.3	<2	Low-----------	0.37	5	<1
	19-51	20-30	0.2-0.6	0.15-0.18	6.1-7.3	<2	Moderate------	0.28		
	51-60	5-15	0.6-2.0	0.08-0.12	6.6-7.8	<2	Low-----------	0.24		
171*, 172*:										
Stohlman--------	0-7	5-15	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.17	1	1-3
	7-16	10-18	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.20		
	16	---	---	---	---	---	-------------	----		
Palls-----------	0-8	5-15	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.17	2	1-3
	8-31	10-18	2.0-6.0	0.08-0.11	6.1-7.3	<2	Low-----------	0.20		
	31	---	---	---	---	---	-------------	----		
173-------------- Subaco	0-13	40-60	0.06-0.2	0.14-0.16	7.4-8.4	<2	High----------	0.24	2	1-3
	13-26	40-60	0.06-0.2	0.14-0.16	7.4-8.4	<2	High----------	0.24		
	26	---	---	---	---	---	-------------	----		

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	In/hr	In/in	pH	mmhos/cm				Pct
174--------------- Tisdale	0-11	27-30	0.2-0.6	0.17-0.19	6.6-7.8	<2	Moderate------	0.28	2	1-3
	11-31	21-35	0.2-0.6	0.14-0.19	6.6-8.4	<2	Moderate------	0.28		
	31	---	---	---	---	---	--------------	----		
175, 176--------- Yuvas	0-16	18-27	0.6-2.0	0.14-0.16	6.1-7.3	<2	Low-----------	0.32	2	<1
	16-24	40-60	<0.06	0.06-0.08	7.4-8.4	<2	High----------	0.24		
	24-38	---	---	---	---	---	--------------	----		
	38	---	---	---	---	---	--------------	----		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
					Ft			In		In			
101*, 102*:													
Altamont	D	None	---	---	>6.0	---	---	40-60	Soft	---	---	High	Low.
Dibble	C	None	---	---	>6.0	---	---	20-40	Soft	---	---	Moderate	Moderate.
103 Byington	C	Rare	---	---	2.0-3.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
104 Capay	D	Rare	---	---	>6.0	---	---	>60	---	---	---	High	Moderate.
105 Capay	D	Occasional	Brief	Dec-Apr	4.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Moderate.
106 Capay	D	Frequent	Long	Dec-Apr	4.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Moderate.
107 Capay	D	Rare	---	---	3.0-5.0	Perched	Jan-Dec	40-60	Soft	---	---	High	Low.
108 Capay	D	Rare	---	---	4.0-5.0	Apparent	Jan-Dec	>60	---	---	---	High	Moderate.
109 Capay	D	Rare	---	---	>6.0	---	---	>60	---	40-60	Thick	High	Low.
110 Clear Lake	D	Rare	---	---	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
111 Clear Lake	D	Frequent	Long	Dec-Apr	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
112 Clear Lake	C	Rare	---	---	4.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Moderate.
113 Clear Lake	C	Frequent	Long	Dec-Apr	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Moderate.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In		In			
114------------- Clear Lake	D	Rare---------	---	---	3.0-5.0	Perched	Dec-Apr	>60	---	40-60	Thick	High-----	Low.
115------------- Clear Lake	D	Rare---------	---	---	3.0-5.0	Perched	Jan-Dec	40-60	Soft	---	---	High-----	Low.
116------------- Clear Lake	D	Frequent----	Long------	Dec-Apr	3.0-5.0	Perched	Jan-Dec	40-60	Soft	---	---	High-----	Low.
117------------- Columbia	C	Rare---------	---	---	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	Moderate	Low.
118------------- Columbia	C	Frequent----	Long------	Dec-Apr	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	Moderate	Low.
119------------- Columbia	C	Rare---------	---	---	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	Moderate	Low.
120------------- Columbia	C	Frequent----	Long------	Dec-Apr	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	Moderate	Low.
121------------- Columbia	C	Frequent----	Long------	Dec-Apr	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	Moderate	Low.
122------------- Columbia	C	Rare---------	---	---	3.0-5.0	Apparent	Dec-Mar	>60	---	---	---	Moderate	Low.
123------------- Cometa	D	None---------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Moderate.
124------------- Conejo	B	None---------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
125------------- Conejo	B	None---------	---	---	>6.0	---	---	40-60	Soft	---	---	High-----	Low.
126*:													
Conejo-----------	B	None---------	---	---	>6.0	---	---	40-60	Soft	---	---	High-----	Low.
Tisdale----------	C	None---------	---	---	>6.0	---	---	20-40	Soft	---	---	High-----	Low.
127*:													
Conejo-----------	B	None---------	---	---	>6.0	---	---	40-60	Soft	---	---	High-----	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Cemented pan: Depth	Cemented pan: Hardness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In		In			
127*: Urban land.													
128------------- Exeter	C	None--------	---	---	>6.0	---	---	>60	---	20-40	Thin	High-----	Low.
129------------- Galt	C	Rare--------	---	---	>6.0	---	---	>60	---	20-40	Thick	High-----	Low.
130------------- Galt	D	Frequent----	Brief to long.	Dec-Apr	>6.0	---	---	>60	---	20-40	Thick	High-----	Low.
131------------- Garretson Variant	B	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
132------------- Gridley	C	None--------	---	---	>6.0	---	---	20-40	Soft	---	---	High-----	Low.
133------------- Holillipah	A	Rare--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
134, 135--------- Holillipah	A	Frequent----	Long------	Dec-Apr	>6.0	---	---	>60	---	---	---	Moderate	Low.
136------------- Holillipah	A	Rare--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
137------------- Jacktone	D	Rare--------	---	---	1.5-3.0	Perched	Dec-Apr	>60	---	20-40	Thick	High-----	Low.
138------------- Liveoak	B	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
139*:													
Liveoak Variant--	B	Frequent----	Long------	Dec-Apr	4.0-6.0	Apparent	Dec-Apr	>60	---	40-60	Thick	High-----	Low.
Galt Variant-----	C	Frequent----	Long------	Dec-Apr	2.0-4.0	Perched	Dec-Apr	22-40	Soft	20-35	Thin	High-----	Low.
140------------- Marcum	C	Rare--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
141------------- Marcum	C	None--------	---	---	>6.0	---	---	40-60	Soft	---	---	High-----	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In		In			
142------ Marcum	C	Occasional	Brief-----	Dec-Apr	>6.0	---	---	>60	---	---	---	High-----	Low.
143*:													
Marcum----------	C	None--------	---	---	>6.0	---	---	40-60	Soft	---	---	High-----	Low.
Gridley---------	C	None--------	---	---	>6.0	---	---	20-40	Soft	---	---	High-----	Low.
144------ Nueva	B	Rare--------	---	---	4.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High-----	Low.
145------ Nueva	B	Occasional	Brief-----	Dec-Apr	4.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High-----	Low.
146------ Nueva	B	Rare--------	---	---	4.0-5.0	Apparent	Jan-Dec	>60	---	---	---	High-----	Low.
147, 148---------- Ocraig	D	None--------	---	---	>6.0	---	---	4-10	Hard	---	---	Moderate	Low.
149*:													
Ocraig----------	D	None--------	---	---	>6.0	---	---	4-10	Hard	---	---	Moderate	Low.
Rock outcrop.													
150, 151---------- Olashes	B	None--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
152------ Olashes	B	Frequent----	Long------	Dec-Apr	>6.0	---	---	>60	---	---	---	Moderate	Low.
153------ Oswald	D	Rare--------	---	---	1.5-3.5	Perched	Dec-Apr	20-40	Soft	---	---	High-----	Low.
154------ Oswald	D	Frequent----	Long------	Dec-Apr	1.5-3.5	Perched	Dec-Apr	20-40	Soft	---	---	High-----	Low.
155*:													
Palls-----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	---	---	Moderate	Low.
Bohna Variant----	B	None--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
					Ft			In		In			
156*, 157*:													
Palls	C	None	---	---	>6.0	---	---	20-40	Hard	---	---	Moderate	Low.
Stohlman	D	None	---	---	>6.0	---	---	10-20	Hard	---	---	Moderate	Low.
158 San Joaquin	D	None	---	---	>6.0	---	---	>60	---	20-40	Thick	Moderate	Moderate.
159 San Joaquin	D	Occasional	Brief	Dec-Apr	>6.0	---	---	>60	---	20-40	Thick	Moderate	Moderate.
160*:													
San Joaquin	D	None	---	---	>6.0	---	---	>60	---	20-40	Thick	Moderate	Moderate.
Arents.													
Durochrepts.													
161 Shanghai	C	Frequent	Long	Dec-Apr	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
162 Shanghai	C	Rare	---	---	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
163 Shanghai	C	Rare	---	---	4.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
164 Shanghai	C	Frequent	Long	Dec-Apr	4.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
165 Shanghai	C	Frequent	Long	Dec-Apr	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
166 Shanghai	C	Frequent	Long	Dec-Apr	2.5-5.0	Apparent	Jan-Dec	>60	---	---	---	High	Low.
167 Shanghai	C	Rare	---	---	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
168 Shanghai Variant	C	Rare	---	---	3.0-5.0	Apparent	Dec-Apr	>60	---	---	---	High	Low.
169 Snelling	B	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In		In			
170--------------- Snelling	B	Occasional	Brief-----	Nov-Apr	>6.0	---	---	>60	---	---	---	High-----	Low.
171*, 172*:													
Stohlman---------	D	None---------	---	---	>6.0	---	---	10-20	Hard	---	---	Moderate	Low.
Palls------------	C	None---------	---	---	>6.0	---	---	20-40	Hard	---	---	Moderate	Low.
173--------------- Subaco	D	Rare---------	---	---	1.5-3.0	Perched	Dec-Apr	20-40	Soft	---	---	High-----	Low.
174--------------- Tisdale	C	None---------	---	---	>6.0	---	---	20-40	Soft	---	---	High-----	Low.
175--------------- Yuvas	D	Rare---------	---	---	>6.0	---	---	22-40	Soft	20-38	Thick	High-----	Low.
176--------------- Yuvas	D	Frequent----	Long------	Dec-Apr	1.5-3.0	Perched	Dec-Apr	22-40	Soft	20-38	Thick	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Altamont	Fine, montmorillonitic, thermic Typic Chromoxererts
Bohna Variant	Fine-loamy, mixed, thermic Typic Argixerolls
Byington	Fine-silty, mixed (calcareous), thermic Aeric Fluvaquents
Capay	Fine, montmorillonitic, thermic Typic Chromoxererts
Clear Lake	Fine, montmorillonitic, thermic Typic Pelloxererts
Columbia	Coarse-loamy, mixed, nonacid, thermic Aquic Xerofluvents
Cometa	Fine, mixed, thermic Typic Palexeralfs
Conejo	Fine-loamy, mixed, thermic Pachic Haploxerolls
Dibble	Fine, montmorillonitic, thermic Typic Haploxeralfs
Exeter	Fine-loamy, mixed, thermic Typic Durixeralfs
Galt	Fine, montmorillonitic, thermic Typic Chromoxererts
Galt Variant	Fine-loamy, mixed, thermic Typic Durochrepts
Garretson Variant	Fine-loamy, mixed (calcareous), thermic Typic Xerorthents
Gridley	Fine, montmorillonitic, thermic Typic Argixerolls
Holillipah	Sandy, mixed, thermic Typic Xerofluvents
Jacktone	Fine, montmorillonitic, thermic Typic Pelloxererts
Liveoak	Fine-loamy, mixed, thermic Typic Haploxerolls
Liveoak Variant	Fine-loamy, mixed, thermic Calcixerollic Xerochrepts
Marcum	Fine, montmorillonitic, thermic Typic Argixerolls
Nueva	Fine-loamy, mixed, thermic Fluventic Haploxerolls
Ocraig	Loamy, mixed, nonacid, thermic Lithic Xerorthents
Olashes	Fine-loamy, mixed, thermic Mollic Haploxeralfs
Oswald	Fine, montmorillonitic, thermic Aquic Chromoxererts
Palls	Coarse-loamy, mixed, thermic Mollic Haploxeralfs
San Joaquin	Fine, mixed, thermic Abruptic Durixeralfs
Shanghai	Fine-silty, mixed, nonacid, thermic Aquic Xerofluvents
Shanghai Variant	Sandy over loamy, mixed, nonacid, thermic Aquic Xerofluvents
Snelling	Fine-loamy, mixed, thermic Typic Haploxeralfs
Stohlman	Loamy, mixed, thermic Lithic Mollic Haploxeralfs
Subaco	Fine, montmorillonitic, thermic Typic Pelloxererts
Tisdale	Fine-loamy, mixed, thermic Typic Haploxerolls
Yuvas	Fine, mixed, thermic Abruptic Durixeralfs

Appendix A

This appendix was extracted from the publication "Aids for Estimating Soil Properties for SCS-Soils-5 Forms in California," dated June 1978. It was prepared by the Soils Staff, USDA, Soil Conservation Service, Davis, California.

Specific Criteria For Determinations

PRIME FARMLANDS

Prime farmland is land best suited for producing food, forage, fiber and oilseed crops and also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land but not urban builtup land or water). It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods.

Prime farmland meets all the following criteria:

1. The soils have:

   a. Aquic, udic, ustic or xeric moisture regimes and an available water capacity of at least 4 inches (10 cm) per 40 to 60 inches (1 to 1.52 meters) of soil to produce the commonly grown cultivated crops (cultivated crops include, but are not limited to, grain, forage, fiber, oilseed, sugarbeets, vegetables, orchard, vineyard, and bush fruit crops) adapted to the region in 7 or more years out of 10; or

   b. Xeric, ustic, aridic or torric moisture regimes in which the available water capacity is at least 4 inches (10 cm) per 40 to 60 inches (1 to 1.52 meters) of soil and the area has a developed irrigation water supply that is dependable (a dependable water supply is one in which enough water is available for irrigation in 8 out of 10 years for the crops commonly grown) and of adequate quality; and,

2. The soils have a temperature regime that is frigid, mesic, thermic or hyperthermic (pergelic and cryic regimes are excluded). These are soils that, at a depth of 20 inches (50 cm), have a mean annual temperature higher than 32 degrees F (0 degrees C). In soils with an O horizon, the mean summer temperature at this depth is higher than 47 degrees F (8 degrees C); in soils that have no O horizon, the mean summer temperature is higher than 59 degrees F (15 degrees C); and,

3. The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1 meter); and,

4. The soils either have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown; and,

5. The soils can be managed so that, in all horizons within a depth of 40 inches (1 meter), during part of each year the conductivity of the saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15; and,

6. The soils are not flooded frequently during the growing season (less often than once in 2 years); and,

7. The product of K (erodibility factor) x percent slope is less than 2.0; and,

8. The soils have a permeability rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches (50 cm) and the mean annual soil temperature at a depth of 20 inches (50 cm) is less than 59 degrees F (15 degrees C); the permeability rate is not a limiting factor if the mean annual soil temperature is 59 degrees F (15 degrees C) or higher; and,

9. Less than 10 percent of the surface layer (upper 6 inches [15 cm]) in these soils consists of rock fragments coarser than 3 inches (7.6 cm); and,

10. The soils have a minimum rooting depth of 40 inches (1 meter).

Appendix B

This appendix consists of California supplement CA-4 to the National Conservation Planning Manual, dated February, 1981, USDA, Soil Conservation Service.

APPENDIX B

GUIDE FOR PLACING SOILS IN LAND CAPABILITY CLASSES

CRITERIA	CAPABILITY CLASS I	II	III	IV	V	VI 12/	VII 13/	VIII
Soil Depth (inches) 1/	≥40	≥40	≥20	≥10	≥20	≥10	Any	Any
ETp 32 degrees F 2/	≥20	≥14	≥10	≥6	≥6	≥4	---	Any
4ETa 3/	≥20	≥16	≥12	≥8	≥8	≥6	≥2	Any
Surface Texture - Irrigated	SL-C	LS-C, may be GR	Any, may be GR, CB	Any, may be GRV, CBV, ST 10/	Any, may be GRX, CBX, STV	Any, may be GRX, CBX, STV	Any	Any
Surface Texture - Nonirrigated	SL-CL	SL-C, may be GR	SL-C, may be GR, CB	LS-C, GRV, CBV, ST 10/	Any, may be GRX, CBX, STV	Any, may be GRX, CBX, STV	Any	Any
Permeability (in./hr.) 4/	0.2-6.0	0.06-20	<0.06-20	Any	Any	Any	Any	Any
Water Table Depth (in.) 5/	>60"	>36"	>20"	>20"	Any	Any	Any	Any
Available Water Capacity 6/	≥7.5" avg AWC ≥0.13 In/In	≥5.0" avg AWC ≥0.08 In/In	≥3.5" avg AWC ≥0.06 In/In	≥2.5" avg AWC ≥0.04 In/In	≥3.0" avg AWC	≥2.0" avg AWC	≥1.0" avg AWC	Any
Slope A 7/	<2%	<5%	<8%	<15%	<2%	<25%	<50%	Any
B	<2%	<8%	<15%	<25%	<2%	<50%	<75%	Any
Erosion Hazard	None or slight	None thru moderate	None thru high	Any	None or slight	Any	Any	Any
Flooding Hazard	None or rare	None thru occas.	None thru occas.	None thru freq. 11/	Any	Any	Any	Any

APPENDIX B, cont.

CRITERIA	CAPABILITY CLASS							
	I	II	III	IV	V	VI 12/	VII 13/	VIII
Salinity ECx10 @ 25 degrees C 8/ mmhos	<4	<8	<16	<16	<8	Dryland <16, Irr. Any	Any	Any
Alkali ESP 8/	None	<25	<50	<50	<25	Dryland <25, Irr. <50	Any	Any
Toxic Substances 9/	None	None or slight	None thru moderate	None thru moderate	None or slight	Dryland slight, Irr. slight thru moderate	Any	Any
Frost-free Season 32 degrees F.-	≥140 days	≥100 days	≥80 days	≥50 days	Any	Any	Any	Any

1/ Clay pans with permeabilities less than 0.06 inches/hour, will be treated as limiting the effective depth.

2/ Potential evapotranspiration for the frost-free season above 32 degrees F. is a relative index for irrigated frost-sensitive crops. ETp 32 degrees F for Marysville, CA is 33. (Thornwaite)

3/ Actual evapotranspiration, 4-inch available water capacity, is a relative index for frost-tolerant dryfarmed crops such as small grains and for pasture and range. 4ETa for Marysville, CA is 12. (Thornwaite)

4/ Permeability of the least permeable subsurface horizon.

5/ Depth to water table during growing season.

6/ Available moisture between field capacity and wilting point.

7/ Group A is used for soils with K factors of 0.37 or greater soils subject to rill and gully erosion, such as soils formed from granitic parent material or with claypans. Other soils in group B.

8/ For salts and alkali to be a major limitation, there should be other soil limitations, such as slow permeabilities or high water tables.

9/ Such as boron and magnesium that leach with difficulty.

10/ Coarse fragments interfere with tillage, but do not prevent cropping.

11/ Frequent flooding that does not prevent normal cropping.

12/ Range and woodland mechanical practices can be applied to class VI land.

13/ Range and woodland mechanical practices are impractical on class VII land.

Appendix C

This appendix consists of materials extracted from the National Soils Handbook, Part II, Notice 24, dated March 31, 1978. These materials provided the basis for many of the interpretive ratings given in this soil survey.

CRITERIA USED IN RATING SOILS FOR SELECTED USES

Following is a list of criteria used in rating soils for selected uses in tables 6, 8, 10, and 11. Soils are rated for the uses expected to be important or potentially important to uses of soil survey information. Ratings for proposed uses are given in terms of limitations and restrictive features, suitability and restrictive features, or only restrictive features. Only the most restrictive features are listed in the tables, therefore, a soil rated severe gives those soil features that cause the soil to be rated severe.

There may be other features that need to be treated to overcome soil limitations for a specific purpose.

The guides that follow show in the first column the properties or features used as criteria for rating the soil for the use. The properties are listed in descending order of estimated importance.

In the "Limits" column, limits of the properties are given for rating the soils and for recognizing a restrictive property or properties.

In the "Restrictive Feature" column is the key phrase that indicates the feature causing the problem.

APPENDIX

C - 1

CAMP AREAS

PROPERTY	LIMITS SLIGHT	LIMITS MODERATE	LIMITS SEVERE	RESTRICTIVE FEATURE
1. Flooding	None, Protected	---	Rare, Common	Floods
2. Slope (%)	0-8	8-15	>15	Slope
3. USDA Texture	---	STV, BYV, CB, FL	STX, BYX, CBX, FLX, CBV, FLV	Large Stones
4. 1/ Coarse Fragments (%) (Surface Layer)	<25	25-50	>50	Small Stones
5. Depth To High Water Table (Ft)	--- >2.5	--- 1.5-2.5	+ <1.5	Ponding Wetness
6. 2/ Permeability (In/Hr) (0-40")	>0.6	0.06-0.6	<0.06	Percs Slowly
7. 2/ USDA Texture (Surface Layer)	---	---	SC, SIC, C	Too Clayey
8. Unified (Surface Layer)	---	---	OL, OH, PT	Excess Humus
9. USDA Texture (Surface Layer)	---	LCOS, VFS	COS, S, FS	Too Sandy
10. Depth To Bedrock (In)	---	---	<20	Depth To Rock
11. Depth To Cemented Pan (In)	---	---	<20	Cemented Pan
12. 3/ USDA Texture (Surface Layer)	---	SIL, SI, VFSL, L	---	Dusty
13. Sodium Adsorption Ratio (Great Group)	---	---	>12 (Natric, Halic)	Excess Sodium
14. Salinity (Mmhos/cm)	<4	4-8	>8	Excess Salt
15. Soil Reaction	---	---	<3.6	Too Acid

1/ 100 minus percent passing No. 10 sieve

2/ Soils in UST, TOR, ARID, BOR, or XER suborders, great groups, or subgroups rate one class better.

3/ Disregard unless soil is in TOR, ARID, or XER suborders, great groups, or subgroups.

APPENDIX

C - 2

PICNIC AREAS

PROPERTY	LIMITS SLIGHT	LIMITS MODERATE	LIMITS SEVERE	RESTRICTIVE FEATURE
1. Slope (%)	0-8	8-15	>15	Slope
2. Flooding	None, Rare, Occas, Protected	Freq	---	Floods
3. Depth To High Water Table (ft)	>2.5 ---	1.0-2.5 ---	<1.0 +	Wetness Ponding
4. USDA Texture	---	STV, BYV, CB, FL	STX, BYX, CBX, FLX, CBV, FLV	Large Stones
5. 1/ USDA Texture (Surface Layer)	---	---	SC, SIC, C	Too Clayey
6. USDA Texture (Surface Layer)	---	LCOS, VFS	COS, S, FS	Too Sandy
7. Unified (Surface Layer)	---	---	OL, OH, PT	Excess Humus
8. 2/ Coarse Fragments (%) (Surface Layer)	<25	25-50	>50	Small Stones
9. Sodium Adsorption Ratio (Great Group)	---	---	>12 (Natric, Halic)	Excess Sodium
10. Salinity (Mmhos/cm)	<4	4-8	>8	Excess Salt
11. Soil Reaction (pH) (Surface Layer)	---	---	<3.6	Too Acid
12. 1/ Permeability (In/Hr) (0-40")	>0.6	0.06-0.6	<0.06	Percs Slowly
13. 3/ USDA Texture (Surface Layer)	---	SIL, SI, VFSL, L	---	Dusty
14. Depth To Bedrock (In)	---	---	<20	Depth To Rock
15. Depth To Cemented Pan (In)	---	---	<20	Cemented Pan

1/ Soils in UST, TOR, ARID, BOR, or XER suborders, great groups, or subgroups rate one class better.

2/ 100 minus percent passing No. 10 sieve.

3/ Disregard unless soil is in TOR, ARID, or XER suborders, great groups, or subgroups.

APPENDIX

C - 3

PLAYGROUNDS

PROPERTY	LIMITS SLIGHT	LIMITS MODERATE	LIMITS SEVERE	RESTRICTIVE FEATURE
1. USDA Texture	---	ST	STV, STX, BYV, BYX, CB, CBV, FL, FLV, BY	Large Stones
2. Slope (%)	0-2	2-6	>6	Slope
3. 1/ Coarse Fragments (%) (Surface Layer)	<10	10-25	>25	Small Stones
4. USDA Texture (Surface Layer)	---	---	SC, SIC, C	Too Clayey
5. USDA Texture (Surface Layer)	---	LCOS, VFS	COS, S, FS	Too Sandy
6. Unified (Surface Layer)	---	---	OL, OH, PT	Excess Humus
7. Depth To High Water Table (Ft)	>2.5 ---	1.5-2.5 ---	<1.5 +	Wetness Ponding
8. Flooding	None, Rare, Protected	Occas	Freq	Floods
9. Depth To Bedrock (In)	>40	4/ 20-40	<20	Depth To Rock
10. Depth To Cemented Pan (In)	>40	4/ 20-40	<20	Cemented Pan
11. 2/ Permeability	>0.6	0.06-0.6	<0.06	Percs Slowly
12. 3/ USDA Texture (Surface Layer)	---	SIL, SI, VFSL, L	---	Dusty
13. Sodium Adsorption	---	---	>12 (Natric, Halic)	Excess Sodium
14. Salinity (Mmhos/cm)	<4	4-8	>8	Excess Salt
15. Soil Reaction (pH) (Surface Layer)	---	---	<3.6	Too Acid

1/ 100 minus percent passing No. 10 sieve.

2/ Soils in UST, TOR, ARID, BOR, or XER suborders, great groups, or subgroups rate one class better.

3/ Disregard unless soil is in TOR, ARID or XER suborders, great groups, or subgroups.

4/ Rate SLIGHT on 0-2% slopes.

APPENDIX

C - 4

PATHS AND TRAILS

PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. Fraction >3 In (Wt %) (Surface Layer)	<25	25-50	>50	Large Stones
2. Depth To High Water Table (Ft)	>2 ---	1-2 ---	0-1 +	Wetness Ponding
3. 1/ USDA Texture (Surface Layer)	---	---	SC, SIC, C	Too Clayey
4. USDA Texture (Surface Layer)	---	LCOS, VFS	COS, S, FS	Too Sandy
5. Unified (Surface Layer)	---	---	OL, OH, PT	Excess Humus
6. Slope (%)	0-15	15-25	>25	Slope
7. Erosion Factor (K) (Surface Layer)	---	---	>.35	Erodes Easily
8. 2/ Coarse Fragments (Wt %) (Surface Layer)	---	---	>65	Small Stones
9. Flooding	Protected, None, Rare, Occas	Freq	---	Floods
10. 3/ USDA Texture (Surface Layer)	---	SIL, SI, VFSL, L	---	Dusty

1/ Soils in UST, TOR, ARID, BOR, or XER suborders, great groups, or subgroups rate one class better.

2/ 100 minus percent passing No. 10 sieve.

3/ Disregard unless soil is in TOR, ARID, or XER suborders, great groups, or subgroups.

APPENDIX

C - 5

SEPTIC TANK ABSORPTION FIELDS

PROPERTY	LIMITS SLIGHT	LIMITS MODERATE	LIMITS SEVERE	RESTRICTIVE FEATURE
1. USDA Texture	---	---	Ice	Permafrost
2. Flooding	None, Protected	Rare	Common	Floods
3. Depth To Bedrock (In)	>72	40-72	<40	Depth To Rock
4. Depth To Cemented Pan (In)	>72	40-72	<40	Cemented Pan
5. Depth To High Water Table (Ft)	--- >6	--- 4-6	+ 0-4	Ponding Wetness
6. Permeability (In/Hr): 24-60" All Layers Below 24"	2.0-6.0 ---	2/ 0.6-2.0 ---	<0.6 >6.0	Percs Slowly Poor Filter
7. Slope (%)	0-8	8-15	>15	Slope
8. 1/ Fraction >3 In (Wt %)	<25	25-50	>50	Large Stones

1/ Weighted average to 40 inches.

2/ Recheck to see if rating should be SLIGHT.

APPENDIX

C - 6

SEWAGE LAGOONS

PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. USDA Texture	---	---	Ice	Permafrost
2. Permeability (In/Hr) (12-60")	<0.6	0.6-2.0	>2.0	Seepage
3. Depth To Bedrock (In)	>60	40-60	<40	Depth To Rock
4. Depth To Cemented Pan (In)	>60	40-60	<40	Cemented Pan
5. Flooding	None, Protected	---	3/ Rare, Common	Floods
6. Slope (%)	0-2	2-7	>7	Slope
7. Unified	---	OL, OH	PT	Excess Humus
8. 1/ Depth To High Water Table (Ft)	--- >5	--- 3.5-5	+ 0-3.5	Ponding Wetness
9. 2/ Fraction 3 In (Wt %)	<20	20-35	>35	Large Stones

1/ If floor of sewage lagoon has slowly permeable material at least 4 feet thick, disregard wetness.

2/ Weighted average to 20 inches.

3/ If floodwater will not enter or damage sewage lagoon (low velocity and depth <5 feet), disregard flooding.

APPENDIX

C - 7

SANITARY LANDFILL (TRENCH)

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA Texture	---	---	Ice	Permafrost
2. Flooding	None, Protected	Rare	Common	Floods
3. Depth To Bedrock (In)	---	---	<72	Depth To Rock
4. Depth To Cemented Pan (In): Thick	---	---	<72	Cemented Pan
Thin	---	<72	---	
5. 1/ Permeability (In/Hr) (Bottom Layer)	---	---	>2.0	Seepage
6. Depth To High Water Table (Ft):	---	---	+	Ponding
Apparent	---	---	0-6	Wetness
Perched	>4	2-4	0-2	Wetness
7. Slope (%)	0-8	8-15	>15	Slope
8. 1/, 2/, 3 USDA Texture	---	CL, SC, SICL	SIC, C	Too Clayey
9. 3/ USDA Texture	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS, SG	Too Sandy
10. 3/ Unified	---	---	OL, OH, PT	Excess Humus
11. 4/ Fraction >3 In (Wt %)	<20	20-35	>35	Large Stones
12. 1/ Sodium Adsorption Ratio (Great Group)	---	---	>12 (Natric, Halic)	Excess Sodium
13. Soil Reaction (pH)	---	---	<3.6	Too Acid
14. Salinity (Mmhos/cm)	---	---	>16	Excess Salt

1/ Disregard in all Aridisols except Salorthids and Aquic intergrades and all Torri great groups of Entisols except Aquic.

2/ If in kaolinitic family, rate one class better if experience confirms.

3/ Thickest layer between 10 and 60 inches.

4/ Weighted average to 60 inches.

APPENDIX

C - 8

SANITARY LANDFILL (AREA)

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA Texture	---	---	Ice	Permafrost
2. Flooding	None, Protected	Rare	Common	Floods
3. Depth To Bedrock (In)	>60	40-60	<40	Depth To Rock
4. Depth To Cemented Pan (In)	>60	40-60	<40	Cemented Pan
5. 1/ Permeability (In/Hr) (10-40")	---	---	>2.0	Seepage
6. Depth To High Water Table (Ft):	---	---	+	Ponding
Apparent	>5	3.5-5	0-3.5	Wetness
Perched	>3	1.5-3	0-1.5	Wetness
7. Slope (%)	0-8	8-15	>15	Slope

1/ Disregard in all Aridisols except Salorthids and Aquic intergrades and all Torri great groups of Entisols except Aquic.

APPENDIX

C - 9

DAILY COVER FOR LANDFILL

PROPERTY	LIMITS GOOD	FAIR	POOR	RESTRICTIVE FEATURE
1. USDA Texture	---	---	Ice	Permafrost
2. Depth To Bedrock (In)	>60	40-60	<40	Area Reclaim
3. Depth To Cemented Pan (In)	>60	40-60	<40	Area Reclaim
4. 1/ Unified	---	---	SP, SW, SP-SM, SW-SM, GP, GW, GP-GM, GW-GM	Seepage
5. 1/, 2/, 3/ USDA Texture	---	CL, SICL, SC	SIC, C	Too Clayey
6. 1/ USDA Texture	---	LCOS, LS, LFS, VFS	S, FS, COS, SG	Too Sandy
7. 1/, 3/ Unified	---	---	OL, OH, CH, MH	Hard To Pack
8. 1, 4/ Coarse Fragments (%)	<25	25-50	>50	Small Stones
9. 1/, 4/ Fraction >3 In (Wt %)	<25	25-50	>50	Large Stones
10. Slope (%)	0-8	8-15	>15	Slope
11. Depth To High Water Table (Ft)	---	---	+	Ponding
	>3.5	1.5-3.5	<1.5	Wetness
12. Unified	---	---	PT	Excess Humus
13. Layer Thickness (In)	>60	40-60	<40	Thin Layer
14. Soil Reaction (pH)	---	---	<3.6	Too Acid
15. 1/, 2/ Salinity (Mmhos/cm)	---	---	>16	Excess Salt
16. 1/, 1 Sodium Adsorption Ratio (Great Group)	---	---	>12 (Halic, Natric)	Excess Sodium

1/ Thickest layer between 10 and 60 inches.

2/ Disregard in all Aridisols except Salorthids and Aquic intergrades and all Torri great groups of Entisols except Aquic.

3/ If in kaolinitic family, rate one class better if experience confirms.

4/ Sum (100 minus percent No. 10 sieve) and fraction >3 in. Use dominant condition for restrictive feature.

APPENDIX

C - 10

SHALLOW EXCAVATIONS

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA Texture	---	---	Ice	Permafrost
2. Depth To Bedrock (In) Hard	>60	40-60	<40	Depth to Rock
Soft	>40	20-40	<20	
3. Depth To Cemented Pan (In): Thick	>60	40-60	<40	Cemented Pan
Thin	>40	20-40	<20	
4. USDA Texture (20-60")	---	2/ SI	COS, S, FS, VFS, LCOS, LS, LFS, LVFS, G, SG	Cutbanks Cave
5. USDA Texture (20-60")	---	C, SIC	---	Too Clayey
6. Soil Order	---	---	Vertisols	Cutbanks Cave
7. Bulk Density (G/CC)	---	>1.8	---	Dense Layer
8. Unified (20-60")	---	---	OL, OH, PT	Excess Humus
9. 1/ Fraction >3 In (Wt %)	<25	25-50	>50	Large Stones
10. Depth To High Water Table (Ft)	---	---	+	Ponding
	>6	2.5-6	0-2.5	Wetness
11. Flooding	None, Rare, Protected	Common	---	Floods
12. Slope (%)	0-8	8-15	>15	Slope

1/ Weighted average to 40 inches.

2/ If loess, rating should be SLIGHT.

APPENDIX

C - 11

DWELLINGS WITHOUT BASEMENTS

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA Texture	---	---	Ice	Permafrost
2. Flooding	None, Protected	---	Rare, Common	Floods
3. Depth To High Water Table (Ft)	--- >2.5	--- 1.5-2.5	+ 0-1.5	Ponding Wetness
4. Shrink-Swell	Low	Moderate	High	Shrink-Swell
5. 1/ Unified	---	---	OL, OH, PT	Low Strength
6. Slope (%)	0-8	8-15	>15	Slope
7. Depth To Bedrock (In): Hard Soft	>40 >20	20-40 <20	<20 ---	Depth To Rock
8. Depth To Cemented Pan (In): Thick	>40 >20	20-40 <20	<20 ---	Cemented Pan
9. 2/ Fraction >3 In (Wt %)	<25	25-50	>50	Large Stones

1/ Thickest layer between 10 and 40 inches.

2/ Weighted average to 40 inches.

APPENDIX

C - 12

DWELLINGS WITH BASEMENTS

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA Texture	---	---	Ice	Permafrost
2. Flooding	None, Protected	---	Rare, Common	Floods
3. Depth To High Water Table (Ft)	---	---	+	Ponding
	>6	2.5-6	0-2.5	Wetness
4. Depth To Bedrock (In): Hard	>60	40-60	<40	Depth To Rock
Soft	>40	20-40	<20	
5. Depth To Cemented Pan (In): Thick	>60	40-60	<40	Cemented Pan
Thin	>40	20-40	<20	
6. Slope (%)	0-8	8-15	>15	Slope
7. 1/ Shrink-Swell	Low	Moderate	High	Shrink-Swell
8. Unified (Bottom Layer)	---	---	OL, OH, PT	Low Strength
9. 2/ Fraction >3 In (Wt %)	<25	25-50	>50	Large Stones

1/ Thickest layer between 10 and 60 inches.

2/ Weighted average to 40 inches.

APPENDIX

C - 13

SMALL COMMERCIAL BUILDINGS

PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. USDA Texture	---	---	Ice	Permafrost
2. Flooding	None, Protected	---	Rare, Common	Floods
3. Depth To High Water Table (Ft)	--- >2.5	--- 1.5-2.5	+ 0.-1.5	Ponding Wetness
4. 1/ Shrink-Swell	Low	Moderate	High	Shrink-Swell
5. Slope (%)	0-4	4-8	>8	Slope
6. 1/ Unified	---	---	OL, OH, PT	Low Strength
7. Depth To Bedrock (In): Hard Soft	>40 >20	20-40 <20	<20 ---	Depth To Rock
8. Depth To Cemented Pan (In): Thick Thin	>40 >20	20-40 <20	<20 ---	Cemented Pan
9. 2/ Fraction >3 In (Wt %)	<25	25-50	>50	Large Stones

1/ Thickest layer between 10 and 40 inches.

2/ Weighted average to 40 inches.

APPENDIX

C - 14

LOCAL ROADS AND STREETS

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA Texture	---	---	Ice	Permafrost
2. Depth To Bedrock (In): Hard	>40	20-40	<20	Depth To Rock
Soft	>20	<20	---	
3. Depth To Cemented Pan (In): Thick	>40	20-40	<20	Cemented Pan
Thin	>20	<20	---	
4. 1/, 2/ AASHTO Group Index Number	0-4	5-8	>8	Low Strength
5. 1/, 3/ AASHTO	---	A-4, A-5	A-6, A-7, A-8	Low Strength
6. Depth To High Water Table (Ft)	---	---	+	Ponding
	>2.5	1.0-2.5	0-1.0	Wetness
7. Slope (%)	0-8	8-15	>15	Slope
8. Flooding	None, Protected	Rare	Common	Floods
9. Potential Frost Action	Low	Moderate	High	Frost Action
10. 1/ Shrink-Swell	Low	Moderate	High	Shrink-Swell
11. 4/ Fraction >3 In (Wt %)	<25	25-50	>50	Large Stones

1/ Thickest horizon between 10 and 40 inches

2/ GIN = (F-35) [.2 + .005 (LL-40)] + .01 (F-15) (PI-10) where F = % passing No. 200 sieve. If F≤35 and PI≥11, use only part 2 of equation. Use median values.

3/ Use AASHTO classification only when group index not known.

4/ Weighted average to 40 inches

APPENDIX

C - 15

LAWNS, LANDSCAPING AND GOLF FAIRWAYS

PROPERTY	LIMITS SLIGHT	MODERATE	SEVERE	RESTRICTIVE FEATURE
1. USDA Texture	---	---	Ice	Permafrost
2. Salinity (Mmhos/Cm) (Surface Layer)	<4	4-8	>8	Excess Salt
3. Sodium Adsorption Ratio (Great Group)	---	---	>12 (Halic, Natric)	Excess Sodium
4. Soil Reaction (pH) (Surface Layer)	---	---	<3.6	Too Acid
5. Sulfidic Materials (Great Group)	---	---	Sulfa-Quents, Sulfi-Hemists	Excess Sulfur
6. 1/ Coarse Fragments (Wt%) (Surface Layer)	<25	25-50	>50	Small Stones
7. Fraction >3 In (Wt %) (Surface Layer)	<5	5-30	>30	Large Stones
8. Depth To High Water Table (Ft)	--- >2	--- 1-2	+ 0-1	Ponding Wetness
9. 2/ Available Water Capacity (In/In)	>.10	.05-.10	<.05	Droughty
10. Flooding	None, Rare, Protected	Occas	Freq	Floods
11. Slope (%)	0-8	8-15	>15	Slope
12. Depth To Bedrock (In)	>40	20-40	<20	Thin Layer
13. Depth To Cemented Pan (In)	>40	20-40	<20	Thin Layer
14. 3/ USDA Texture (Surface Layer)	---	---	SIC, C, SC	Too Clayey
15. USDA Texture (Surface Layer)	---	---	FB, HM, MUCK, SP, MPT, PEAT	Excess Humus
16. USDA Texture (Surface Layer)	---	LCOS, S	COS	Too Sandy

1/ 100 minus percent passing No. 10 sieve

2/ Weighted average to 40 inches

3/ If in kaolinitic family, rate one class better if experience confirms.

APPENDIX

C - 16

ROADFILL

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	GOOD	FAIR	POOR	
1. USDA Texture	---	---	Ice	Permafrost
2. Depth To Bedrock (In)	>60	40-60	<40	Area Reclaim
3. 1/, 2/ AASHTO Group Index Number	0-4	5-8	>8	Low Strength
4. 2/, 3/ AASHTO	---	A-4	A-5, A-6, A-7, A-8	Low Strength
5. Layer Thickness (In)	>60	30-60	<30	Thin Layer
6. 4/ Fraction >3 In (Wt %)	<25	25-50	>50	Large Stones
7. Depth To High Water Table (Ft)	>3	1-3	<1	Wetness
8. Slope (%)	0-15	15-25	>25	Slope
9. 2/ Shrink-Swell	Low	Moderate	High	Shrink-Swell

1/ GIN = (F-35) [.2 + .005 (LL-40)] + .01 (F-15) (PI-10) where F = % passing No. 200 sieve. If F $\leq$ 35 and PI $\geq$ 11, use only part 2 of equation. Use median values.

2/ Evaluate the thickest layer between 10 and 60 inches and also the bottom layer. Choose the best rating. When rating is based on bottom layer, verify thickness.

3/ Use AASHTO classification only when group index not known.

4/ Weighted average to 40 inches

APPENDIX

C - 17

SAND

PROPERTY	LIMITS		RESTRICTIVE FEATURE
	PROBABLE SOURCE	IMPROBABLE SOURCE	
1. 1/ Unified	SW, SP, SW-SM SP-SM		
	3/ GW, GP, GW-GM, GP-GM		
		4/ GW, GP, GW-GM, GP-GM	Small Stones
		All Other	Excess Fines
2. Layer Thickness (In)	>36	<36	Thin Layer
3. 2/ Fraction >3 In (Wt %)	<50	>50	Large Stones

1/ Evaluate the thickest layer between 10 and 60 inches and also the bottom layer. Choose best rating. When rating is based on bottom layer, verify thickness.

2/ Thickest layer between 10 and 60 inches.

3/ % passing No. 4 sieve, minus % passing No. 200 sieve >25.

4/ % passing No. 4 sieve, minus % passing No. 200 sieve <25.

APPENDIX

C - 18

GRAVEL

PROPERTY	LIMITS		RESTRICTIVE FEATURE
	PROBABLE SOURCE	IMPROBABLE SOURCE	
1. 1/ Unified	GW, GP, GW-GM, GP-GM		
	3/SW, SP, SW-SM, SP-SM	4/ SW, SP, SW-SM, SP-SM	Too Sandy
		All Other	Excess Fines
2. Layer Thickness	>36	<36	Thin Layer
3. 2/ Fraction >3 In (Wt %)	<50	>50	Large Stones

1/ Evaluate the thickest layer between 10 and 60 inches and also the bottom layer. Choose best rating. When rating is based on bottom layer, verify thickness.

2/ Thickest layer between 10 and 60 inches.

3/ 100 minus % passing No. 4 sieve >25

4/ 100 minus % passing No. 4 sieve <25

APPENDIX

C - 19

TOPSOIL

PROPERTY	LIMITS GOOD	FAIR	POOR	RESTRICTIVE FEATURE
1. Depth To Bedrock (In)	>40	20-40	<20	Area Reclaim
2. Depth To Cemented Pan (In)	>40	20-40	<20	Area Reclaim
3. Depth To Bulk Density >1.8 (G/CC) (In)	>40	20-40	<20	Area Reclaim
4. USDA Texture (0-40")	---	LCOS, LS, LFS, LVFS	COS, S, FS, VFS	Too Sandy
5. USDA Texture (0-40")	---	2/ SCL, CL, SICL	SIC, C, SC	Too Clayey
6. USDA Texture (0-40")	---	---	FB, HM, SP, MPT, MUCK, PEAT, CE	Excess Humus
7. 1/ Fraction >3 In (Wt %): 0-40"	<5	5-25	>25	Large Stones
40-60"	<15	15-30	>30	Area Reclaim
8. 1/ Coarse Fragments (%): 0-40"	<5	5-25	>25	Small Stones
40-60"	<25	25-50	>50	Area Reclaim
9. Salinity (Mmhos/Cm) 0-40"	<4	4-8	>8	Excess Salt
10. Layer Thickness (In)	>40	20-40	<20	Thin Layer
11. Depth To High Water Table (Ft)	---	---	<1	Wetness
12. Sodium Adsorption Ratio (Great Group)	---	---	>12 (Halic, Natric, Alkali Phases)	Excess Sodium
13. Soil Reaction (pH) (0-40")	---	---	<3.6	Too Acid
14. Slope (%)	0-8	8-15	>15	Slope

1/ Sum (100 minus percent passing No. 10 sieve) and fraction >3 in. Use dominant condition for restrictive feature.

2/ If soil contains >3% organic matter and has less than 35% clay, rate GOOD.

APPENDIX

C - 20

POND RESERVOIR AREA

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA Texture	---	---	Ice	Permafrost
2. Permeability (In/Hr) (20-60")	<0.6	0.6-2.0	>2.0	Seepage
3. Depth (In) To Layer With Perm >2.0	>60	40-60	<40	Seepage
4. Depth To Bedrock (In)	>60	20-60	<20	Depth To Rock
5. Depth To Cemented Pan (In)	>60	20-60	<20	Cemented Pan
6. Slope (%)	<3	3-8	>8	Slope
7. USDA Texture	---	---	MARL, GYP	Seepage

APPENDIX

C - 21

EMBANKMENTS, DIKES, AND LEVEES

PROPERTY	LIMITS			RESTRICTIVE FEATURE
	SLIGHT	MODERATE	SEVERE	
1. USDA Texture	---	---	Ice	Permafrost
2. Layer Thickness (In)	>60	30-60	<30	Thin Layer
3. 1/ Unified	---	---	GW, GP, SW, SP, GW-GM, GP-GM, SW-SM, 5/ SM, GM	Seepage
4. 1/ Unified	---	3/ GM, 4/ CL	6/ ML, 7/ SM, SP, CL-ML	Piping
5. 1/ Unified	---	---	PT, OL, OH	Excess Humus
6. 1/ Unified	---	---	MH, 8/ CH	Hard To Pack
7. 2/Fraction >3" (Wt %)	<15	15-35	>35	Large Stones
8. Depth To High Water Table (Ft):	---	---	+	Ponding
Apparent	>4.0	2.0-4.0	<2.0	Wetness
Perched	>3.0	1.0-3.0	<1.0	Wetness
9. Sodium Adsorption Ratio (Great Group)	---	---	>12 (Natric, Halic)	Excess Sodium
10. Salinity (Mmhos/Cm)	<8	8-16	>16	Excess Salt

1/ Thickest horizon between 10 and 60 inches
2/ Weighted average to 40 inches
3/ Rate SLIGHT if <35% passing No. 200 sieve and <50% passing No. 40 and <65% passing No. 10 sieve.
4/ Rate SLIGHT if PI>15.
5/ Rate MODERATE if >20% passing No. 200 sieve and SLIGHT if >30% passing No. 200 sieve.
6/ Rate MODERATE if PI>10.
7/ Rate MODERATEif <70% passing No. 40 sieve and <90% passing No. 10 sieve, and rate SLIGHT if <60% passing No. 40 sieve and <75% passing No. 10 sieve.
8/ Rate MODERATE of PI<40.

APPENDIX

C - 22

DRAINAGE

PROPERTY	LIMITS	RESTRICTIVE FEATURE
1. USDA Texture	Ice	Permafrost
2. 1/ Depth To High Water Table (Ft)	2/ >3 +	Deep To Water Ponding
3. Permeability (In/Hr)	<0.2	Percs Slowly
4. Depth To Bedrock (In)	<40	Depth To Rock
5. Depth To Cemented Pan (In)	<40	Cemented Pan
6. Flooding	Common	Floods
7. Total Subsidence	Any Entry	Subsides
8. Fraction >3 In (Wt %)	>25	Large Stones
9. Potential Frost Action	High	Frost Action
10. Slope (%)	>3	Slope
11. USDA Texture	COS, S, FS, VFS, LCOS, LS, LFS, LVFS, SG, G	Cutbanks Cave
12. Salinity (Mmhos/Cm)	>8	Excess Salt
13. Sodium Adsorption Ration (Great Group)	>12 (Natric, Halic)	Excess Sodium
14. Sulfidic Materials (Great Group)	Sulfaquents, Sulfihemists	Excess Sulfur
15. Soil Reaction (pH)	<3.6	Too Acid
16.	None Of Above	Favorable

1/ If DEEP TO WATER, disregard other properties.

2/ If irrigated, consider other restrictive features if the water table is between 3 and 5 feet.

APPENDIX

C - 23

IRRIGATION

PROPERTY	LIMITS	RESTRICTIVE FEATURE
1. 1/ Fraction >3 In (Wt %)	>25	Large Stones
2. Depth To High Water Table (Ft)	<3 +	Wetness Ponding
3. 1/ Available Water Capacity (In/In)	<0.10	Droughty
4. USDA Texture (Surface Layer)	S, FS, VFS, LS, LFS, LVFS	Fast Intake
5. USDA Texture (Surface Layer)	SIC, C, SC	Slow Intake
6. Wind Erodibility Group	1, 2, 3	Soil Blowing
7. Permeability (In/Hr) (0-60")	<0.2	Percs Slowly
8. Depth To Bedrock (In)	<40	Depth To Rock
9. Depth To Cemented Pan (In)	<40	Cemented Pan
10. Fragipan (Great Group)	All Fragi	Rooting Depth
11. Bulk Density (G/CC) (0-40")	>1.7	Rooting Depth
12. Slope (%)	>3	Slope
13. Erosion Factor (K) (Surface Layer)	>.35	Erodes Easily
14. Flooding	Common	Floods
15. Sodium Adsorption Ratio (Great Group)	>12 (Natric, Halic)	Excess Sodium
16. Salinity (Mmhos/Cm)	>8	Excess Salt
17. Soil Reaction (pH)	<3.6	Too Acid
18.	None Of Above	Favorable

1/ Weighted average to 40 inches

APPENDIX

C - 24

TERRACES AND DIVERSIONS

PROPERTY	LIMITS	RESTRICTIVE FEATURE
1. USDA Texture	Ice	Permafrost
2. Slope (%)	>8	Slope
3. 1/ Fraction >3 In (Wt. %)	>15	Large Stones
4. Depth To Bedrock (In)	<40	Depth To Rock
5. Depth To Cemented Pan (In)	<40	Cemented Pan
6. Erosion Factor (K) (0-40")	>.35	Erodes Easily
7. Depth To High Water Table (Ft)	<3.0 +	Wetness Ponding
8. Fragipan (Great Group)	All Fragi	Rooting Depth
9. 2/ USDA Texture	COS, S, FS, LS, LCOS, SG	Too Sandy
10. Wind Erodibility Group	1, 2, 3	Soil Blowing
11. Permeability (In/Hr)	<0.2	Percs Slowly
12.	None Of Above	Favorable

1/ Weighted average to 40 inches

2/ Thickest layer between 10 and 60 inches

APPENDIX

C - 25

GRASSED WATERWAYS

PROPERTY	LIMITS	RESTRICTIVE FEATURE
1. 1/ Fraction >3 In (Wt. %)	>15	Large Stones
2. Depth To High Water Table (Ft)	<1.5	Wetness
3. Slope (%)	>8	Slope
4. Salinity (Mmhos/Cm)	>4	Excess Salt
5. Sodium Adsorption Ratio (Great Group)	>12 (Natric, Halic)	Excess Sodium
6. Erosion Factor (K) (0-40")	>.35	Erodes Easily
7. 1/ Available Water Capacity (In/In)	<0.10	Droughty
8. Depth To Bedrock (In)	<40	Depth To Rock
9. Depth To Cemented Pan (In)	<40	Cemented Pan
10. Fragipan (Great Group)	All Fragi	Rooting Depth
11. Bulk Density (G/CC) (0-40")	>1.7	Rooting Depth
12. Permeability (In/Hr) (0-40")	<0.2	Percs Slowly
13.	None Of Above	Favorable

1/ Weighted average to 40 inches

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