SOIL SURVEY OF

Napa County, California

United States Department of Agriculture
Soil Conservation Service
In cooperation with
University of California
Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. 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 who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1965–73. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1974. This survey was made cooperatively by the Soil Conservation Service and the University of California Agricultural Experiment Station. It is part of the technical assistance furnished to the Napa County Resource Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Napa County, California, contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

All the soils of Napa County are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described and also the page of the capability unit and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the interpretative groupings.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Wildlife."

Engineers and builders will find under "Engineering" tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation, morphology and classification of the soils."

Students, teachers and others will find information about soils and their management in various parts of the text, depending on their particular interests.

Newcomers in Napa County may be especially interested in the section "General soil map for broad land use planning," where broad patterns of soils are described. They may also be interested in the section "General nature of the county."

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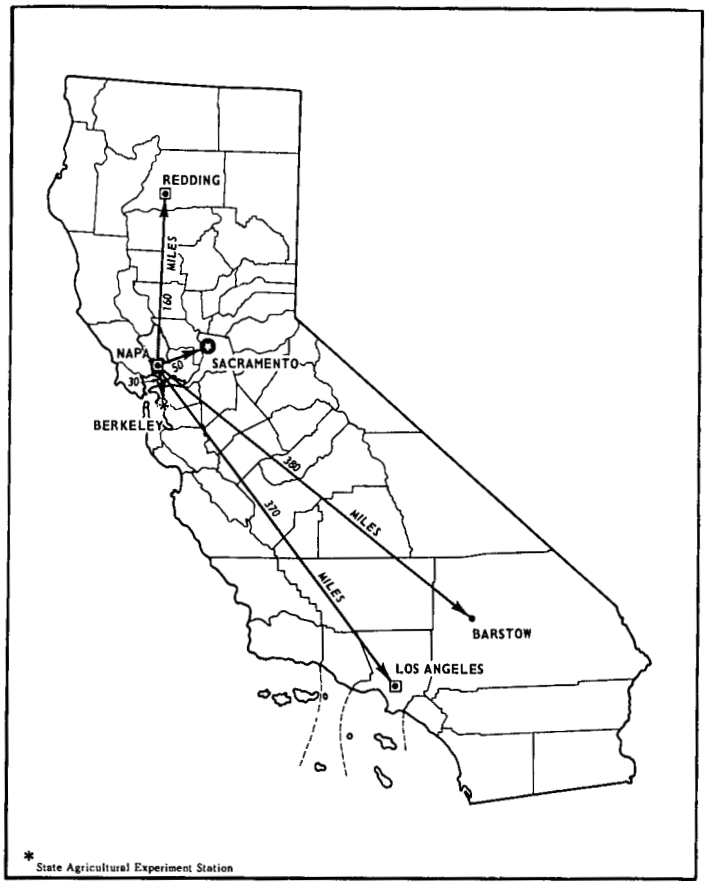

Location of Napa County in California.

SOIL SURVEY OF NAPA COUNTY, CALIFORNIA

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Fieldwork by G. Lambert, J. Kashiwagi, B. Hansen, P. Gale, and A. Endo, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with University of California Agricultural Experiment Station

NAPA COUNTY is in the north-coast part of California (see facing page). It is part of the California Coast Range. The area of the county is approximately 485,120 acres, or 758 square miles. Elevation ranges from nearly sea level to 4,000 feet.

Napa, the largest city in the county and the county seat, is in the southern part of the county. Other important communities are Yountville, St. Helena, and Calistoga. State Highway 29, a north-south highway, extends the length of the county.

Napa Valley dissects the county in a northwesterly direction from the San Pablo Bay to Calistoga. The valley varies in width from 1 mile near Calistago to 5 miles near the San Pablo Bay. The soils of Napa Valley and other inland valleys in Napa County are nearly level and are intensively cultivated. The rest of the county is rolling to steep uplands that are used for range, wildlife habitat, and recreation.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in Napa County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have a profile almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similiar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Bale and Reyes, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such difference, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Clear Lake clay, overwashed, is one of several phases within the Clear Lake series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. Three such kind of mapping units—soil complexes and soil associations—are shown on the soil map of Napa County.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the

time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Maymen-Millsholm-Lodo association, 30 to 75 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called miscellaneous areas and are given descriptive names, such as "Rock outcrop," which is a land type in Napa County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of the soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General soil map for broad land use planning

The general soil map at the back of this publication shows, in color, the soil associations described in this survey. Each soil association is a unique natural landscape unit that has a distinct pattern of soils and of relief and drainage features. An association typically consists of one or more soils of major extent and some soils of minor extent. It is named for the major soils. The kinds of soil in one association can occur in other soil associations, but in a different pattern.

The map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are generally suitable for certain kinds of farming or other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it 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 kinds of soils in any one soil association ordinarily differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

The 11 soil associations in Napa County are described on the following pages. The associations have been grouped into two general kinds of landscape. Four associations are on alluvial fans, flood plains, valleys, and terraces; seven are on uplands.

The terms for texture used in the title of the association apply to the surface layer. For example, in the title for association 1, the words "loams, silt loams, and clay loams" refer to texture of the surface layer.

Well drained to poorly drained, nearly level to moderately steep soils on alluvial fans, on flood plains, in basins, on tidal flats, and on terraces

These soils are well drained to poorly drained loams to clays that formed in alluvium from sedimentary and igneous rocks. Elevation ranges from slightly below sea level to 500 feet. Average annual precipition is 20 to 40 inches, and average annual air temperature is about 58° to 62° F. The frost-free season is 220 to 300 days.

The four soil units in this group make up about 16 percent of Napa County. These soils are used extensively for vineyards and orchards and for irrigated pasture in small areas where water is available.

1. Bale-Cole-Yolo

Nearly level to gently sloping, well drained and somewhat poorly drained loams, silt loams, and clay loams on flood plains, alluvial fans, and terraces

This unit is mainly in Napa Valley on flood plains and alluvial fans along the Napa River, Dry Creek, Conn Creek, and Napa Creek. Smaller areas are on the flats around Carneros south of State Highway 12. Slope is 0 to 5 percent. Elevation ranges from 100 to 500 feet. The soils formed in deep deposits of alluvium derived mainly from basic igneous and rhyolitic bedrock. The plant cover consists of annual grasses, forbs, willows, blackberry, and scattered oak. Average rainfall is 25 to 40 inches, and average annual air temperature is 58° to 62° F. The frost-free season is 220 to 270 days.

This unit makes up about 6 percent of the county. It is about 45 percent Bale soils, 25 percent Cole soils, and 15 percent Yolo soils. The remaining 15 percent is mainly Clear Lake, Coombs, Cortina, and Pleasanton soils and frequently flooded Riverwash.

Bale soils are somewhat poorly drained. The surface layer is dark gray loam or clay loam. The subsoil is brown loam or clay loam. Below the subsoil are stratified layers of gray loam and pale brown gravelly sandy loam and sandy loam. In places a seasonal water table is at a depth of 3 to 5 feet.

Cole soils are somewhat poorly drained. The surface layer is grayish brown silt loam. The subsoil is dark gray silty clay loam. The substratum is grayish brown clay loam and clay. In places a seasonal water table is at a depth of 3 to 5 feet.

Yolo soils are well drained. The surface layer is

dark grayish brown loam and silt loam. The underlying material is dark grayish brown and brown silt loam.

These soils are among the most productive in the county. They are used for many kinds of wine grape vineyards and orchards. Some areas, particularly those adjacent to the major waterways, are subject to occasional flooding.

2. Tehama

Nearly level to gently sloping, well drained silt loams on flood plains and alluvial fans

This unit is mainly in Pope Valley and on flats bordering the east side of Lake Berryessa. Slope is 0 to 5 percent. Elevation ranges from 200 to 500 feet. The soils formed in deep alluvium derived from sedimentary rock. The plant cover consists of annual grasses, forbs, and scattered oak. Average annual precipitation is 25 to 35 inches, and average annual air temperature is 59° to 62° F. The frost-free season is 250 to 260 days.

This unit makes up about 3 percent of the county. It is about 80 percent Tehama soils. The remaining 20 percent is Cole, Pleasanton, Maxwell, and Contra Costa soils.

Tehama soils are well drained. The surface layer is pale brown silt loam. The subsoil extends to a depth of 60 inches or more. It is brown and dark grayish brown silty clay loam.

These soils are used mainly for pasture, some vineyards, and irrigated pasture.

3. Reyes-Clear Lake

Nearly level, poorly drained silty clay loams and clays on tidal flats, in basins, and on basin rims

This unit is in the extreme southwestern part of Napa County. Slope is generally 0 to 2 percent. In small areas along basin rims near Napa Junction west of State Highway 29, slope is 2 to 5 percent. Elevation ranges from slightly below sea level to 250 feet. The soils formed in alluvium from sedimentary and basic igneous rocks. The plant cover consists of tule, saltgrass, annual grasses, forbs, and scattered oak. Average annual precipitation is 20 to 30 inches, and average annual air temperature is 59° to 62° F. The frost-free season is 220 to 300 days.

This unit makes up 4 percent of the county. It is about 60 percent Reyes soils and 30 percent Clear Lake soils. The remaining 10 percent is mostly Egbert, Haire, and Cole soils.

In Reyes soils, the surface layer is light brownish gray and gray silty clay loam. The subsoil is pinkish gray mucky silty clay loam. The substratum is light gray silty clay loam. In places it is stratified muck and peat below a depth of 50 to 60 inches.

In Clear Lake soils, the surface layer is very dark gray clay. The underlying material is light olive brown calcareous clay. In some small areas in Napa Valley, these soils are free of lime.

These soils are used for salt basins, oat hay, small grain, annual pasture, and limited wine grape vineyards.

4. Haire-Coombs

Nearly level to moderately steep, moderately well drained and well drained gravelly loams, loams, and clay loams on terraces

This unit is on old terraces mainly near El Centro-Salvador Avenue, Green Island Road, Big Ranch Road, Monticello Road, and Napa County Airport. Slope is 0 to 30 percent. Elevation ranges from 20 to 500 feet. The soils formed in alluvium from sedimentary and igneous rocks. The plant cover consists of annual grasses, forbs, and a few scattered oaks. Average annual precipitation is 24 to 30 inches, and average annual air temperature is 58° to 62° F. The frost-free season is 220 to 260 days.

This unit makes up about 3 percent of the county. It is about 65 percent Haire soils and 20 percent Coombs soils. The remaining 15 percent is mainly Clear Lake, Cole, Reyes, Tehama, Pleasanton, and Yolo soils.

Haire soils are moderately well drained. The surface layer is brown and grayish brown loam or clay loam. The subsoil extends to a depth of 60 inches or more. It is pale brown and pale yellow clay and sandy clay.

Coombs soils are well drained. The surface layer is brown and pale brown gravelly loam and clay loam. The subsoil is brown, light brown, and pink clay loam. The substratum is very gravelly loamy fine sand.

These soils are used mostly for pasture. Some areas are in varietal vineyards and Christmas trees, and a few small areas are in irrigated pasture.

Excessively drained to well drained, gently sloping to very steep soils on uplands

These soils are excessively drained gravelly loams to clay loams. Elevation ranges from 200 to 4,300 feet. Average annual precipitation to 20 to 60 inches, and average annual air temperature is 50° to 64° F. The frost-free season is 200 to 260 days.

The seven soil units in this group make up about 84 percent of Napa County. They are scattered throughout the county. The more gently sloping soils are used for limited vineyards and for orchards. The steeper soils are used for dryland hay and grain or for range. The very steep soils are used for watershed and wildlife habitat.

5. Bressa-Dibble-Sobrante

Moderately sloping to very steep, well drained loams, silt loams, and silty clay loams on uplands

This unit is east, north, and northwest of Lake Berryessa. It also is near Wooden Valley and south of Browns Valley. Slope is 5 to 75 percent. Elevation ranges from 200 to 2,000 feet. The soils formed in material weathered from sandstone and shale. The plant cover consists of annual grasses, forbs, and scattered oak. Average annual precipitation is 25 to 35 inches, and average annual air temperature is 59° to 64° F. The frost-free season is 220 to 260 days.

This unit makes up 29 percent of the county. It is about 60 percent Bressa soils, 15 percent Dibble soils, and 15 percent Sobrante soils. The remaining 10 percent is Contra Costa, Lodo, Los Gatos, and Millsholm

soils. The Bressa and Dibble soils are so intermingled that they are mapped as complexes.

In Bressa soils, the surface layer is pale brown silt loam. The subsoil is light yellowish brown and yellowish brown silty clay loam. Fractured sandstone or shale is at a depth of 30 to 40 inches.

In Dibble soils, the surface layer is pale brown and brown silty clay loam. The subsoil is brown silty clay and yellowish brown clay. Shattered sandstone or shale is at a depth of 20 to 40 inches.

In Sobrante soils, the surface layer is brown loam. The subsoil is reddish yellow, light brown, and pink clay loam. Massive sandstone is at a depth of 25 to 40 inches.

These soils are used mostly for range. Small areas of the more gently sloping soils are used for varietal vineyards and orchards.

6. Henneke-Montara

Moderately sloping to very steep, excessively drained and well drained gravelly loams and clay loams on uplands

This unit is near Butts Canyon south of Snell Valley, around Cedar Valley and Adams Ridge west of the Knoxville-Berryessa Road, and in Soda Valley. Slope is 5 to 75 percent. Elevation ranges from 500 to 4,000 feet. The soils formed in material weathered from serpentine. The plant cover consists of digger pine, scrub oak, manzanita, muskbush, toyon, and a few annual grasses. Average annual precipitation is 20 to 45 inches, and average annual air temperature is 59° to 62° F. The frost-free season is 220 to 260 days.

This unit makes up about 18 percent of the county. It is about 75 percent Henneke soils and 10 percent Montara soils. The remaining 15 percent is Bressa, Dibble, Guenoc, Lodo, Los Gatos, and Maymen soils.

Henneke soils are excessively drained. The surface layer is reddish brown gravelly loam. The subsoil is reddish brown very gravelly clay loam. Weathered and fractured greenish blue serpentine is at a depth of 10 to 20 inches.

Montara soils are well drained. The surface layer is grayish brown and dark grayish brown clay loam. Serpentine is at a depth of 10 to 15 inches.

These soils are used for watershed, wildlife habitat, and recreation. Where adjoining soils are grazed, these soils are used for limited grazing.

7. Maymen-Lodo-Felton

Steep to very steep, somewhat excessively drained and well drained gravelly loams and loams on uplands

This unit is in the Dry Creek-Oakville Grade area, near Zim-Zim Creek west of the Knoxville-Berryessa Road, and in the area due west of Spanish Flat around Lake Berryessa. Slope is 30 to 75 percent. Elevation ranges from 300 to 2,500 feet. The soils formed in material weathered from sandstone and shale. The plant cover consists of chapparal, chamise, manzanita, scrub oak and Douglas-fir, ponderosa pine, fern, bay, and annual grasses. Average annual precipitation is 25 to 40 inches, and average annual temperature is 54° to 62° F. The frost-free season is 220 to 260 days.

This unit makes up 10 percent of the county. It is about 40 percent Maymen soils, 15 percent Lodo soils, and 15 percent Felton soils. The remaining 30 percent is Millsholm soils and some areas of Forward, Kidd, and Sobrante soils.

Maymen soils are somewhat excessively drained. The surface layer is pale brown gravelly loam. The subsoil is light yellowish brown gravelly loam. Fractured sandstone and shale are at a depth of 10 to 16 inches.

Lodo soils are somewhat excessively drained. The surface layer is brown loam. The subsoil is brown heavy loam. Fractured sandstone and shale are at a depth of 6 to 20 inches.

Felton soils are well drained. The surface layer is dark grayish brown gravelly loam. The subsoil is dark brown and brown clay loam in the upper part and reddish yellow clay loam in the lower part. Weathered sandstone and shale are at a depth of 30 to 40 inches.

These soils are used for timber, wildlife habitat, recreation, and watershed. Some small grassy areas are used for cattle browse on a very limited basis.

8. Rock outcrop-Kidd-Hambright

Rock outcrop and gently sloping to very steep, well drained very stony loams and loams on uplands

This unit is around Blue Ridge bordering Yolo County, in the Oat Hill-Palisade Ridge area in the northwestern part of the county, and in the Soda Canyon-Atlas Peak area. Slope is 2 to 75 percent. Elevation ranges from 400 to 4,300 feet. The soils formed in material weathered from rhyolite and basic igneous rocks. The plant cover consists of small shrubs, lichens, scattered brush, and patches of annual grasses and forbs. Average annual precipitation is 20 to 60 inches, and average annual temperature is 50° to 62° F. The frost-free season is 200 to 260 days.

This unit makes up 9 percent of the county. It is about 60 percent Rock outcrop, 15 percent Kidd soils, and 15 percent Hambright soils. The remaining 10 percent is Lodo, Maymen, and Millsholm soils.

Rock outcrop consists of basic igneous boulders, massive rhyolitic escarpments, stones, or outcrop areas of 1 to 5 acres. Intermingled are small areas of soils that are generally less than 6 inches deep over sedimentary or igneous bedrock.

In the Kidd soils, the surface layer is grayish brown loam. The subsoil is very pale brown loam. Shattered rhyolitic tuff is at a depth of 12 to 15 inches.

In the Hambright soils, the surface layer is dark grayish brown and brown very stony loam. The subsoil is dark brown stony loam. Fractured basic igneous bedrock is at a depth of 10 to 20 inches.

These soils and Rock outcrop are used for watershed, wildlife habitat, and recreation.

9. Forward-Boomer-Felta

Gently sloping to very steep, well drained loams, gravelly loams, and very gravelly loams on uplands

This unit is on the uplands bordering Sonoma County, between Spring Mountain and Petrified Forest Road. Slope is 2 to 75 percent. Elevation ranges from 300 to 3,500 feet. The soils formed in material weathered from acidic and basic igneous rocks and in gravelly old alluvium that was uplifted in volcanic areas.

The plant cover consists of Douglas-fir, ponderosa pine, black oak, manzanita, poison-oak, madrone, and sparse grasses. Average annual precipitation is 30 to 50 inches, and average annual air temperature is 53° to 62° F. The frost-free season is 200 to 260 days.

This unit makes up about 8 percent of the county. It is about 40 percent Forward soils, 30 percent Boomer soils, and 15 percent Felta soils. The remaining 15 percent is Kidd and Aiken soils.

In the Forward soils, the surface layer is light gray gravelly loam. The subsoil is light gray loam. The substratum is light gray gravelly loam. Weathered rhyolitic tuff is at a depth of 20 to 40 inches.

In Boomer soils, the surface layer is brown loam. The subsoil is brown clay loam and yellowish red clay loam. The substratum is pink clay loam. Weathered igneous bedrock is at a depth of 40 to 60 inches or more.

In Felta soils, the surface layer is grayish brown very gravelly loam. The subsoil is grayish brown very gravelly clay loam. The substratum is brown very gravelly sandy clay loam. Old river sediment is at a depth of 40 to 60 inches or more.

These soils are used for timber, wildlife habitat, recreation, and watershed.

10. Forward-Aiken

Gently sloping to steep, well drained gravelly loams and loams on uplands

This unit is in the Angwin-Los Posadas Forest area. Slope is 2 to 50 percent. Elevation ranges from 300 to 3,500 feet. The soils formed in material weathered from basic and acidic igneous bedrock. The plant cover generally consists of conifers, madrone, poison-oak, tan oak, and manzanita. Redwood are in draws that have surplus moisture. Brush has encroached on some cleared areas. Average annual precipitation is 30 to 50 inches, and average annual air temperature is 54° to 56° F. The frost-free season is 200 to 250 days.

This unit makes up about 5 percent of the county. It is about 45 percent Forward soils and 35 percent Aiken soils. The remaining 20 percent is mainly Boomer, Kidd, and Sobrante soils.

In Forward soils, the surface layer is light gray gravelly loam. The subsoil is light gray loam. The substratum is light gray gravelly loam. Weathered rhyolitic tuff is at a depth of 20 to 40 inches.

In Aiken soils, the surface layer is reddish brown loam. The subsoil is yellowish red clay. Hard basic igneous bedrock is at a depth of 40 to 60 inches.

These soils are used mainly for timber. At lower elevations, some small areas are used for vineyards or orchards.

11. Fagan-Millsholm

Moderately sloping to very steep, well drained loams and clay loams on uplands

This unit is in southeastern Napa County around Jameson Canyon and American Canyon. Slope is 5 to 75 percent. Elevation ranges from 200 to 2,500 feet. The soils formed in material weathered from shale and sandstone. The plant cover consists of annual grasses, forbs, sparse perenial grasses, and some oak, mainly on north-facing side slopes. Average annual precipitation is 20 to 35 inches, and average annual air temperature is 59° to 62° F. The frost-free season is 220 to 260 days.

This unit makes up about 5 percent of the county. It is about 50 percent Fagan soils and 30 percent Millsholm soils. The remaining 20 percent is Bressa, Diablo, Dibble, Haire, Lodo, and Maymen soils.

In Fagan soils, the surface layer is dark grayish brown clay loam. The subsoil is dark grayish brown clay in the upper part and light yellowish brown sandy clay loam in the lower part. Soft sandstone is at a depth of 40 to 60 inches.

In Millsholm soils, the surface layer is pale brown loam. The subsoil is yellowish brown clay loam. Sandstone is at a depth of 10 to 20 inches.

These soils are used mainly for range and pasture. There are some dairy enterprises.

Descriptions of the soils

This section describes each soil series in detail and then, briefly, each mapping unit in that series. Unless stated otherwise, what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface down to rock or other underlying material. Each series contains two descriptions of the profile. The first is brief and in terms familiar to a layman. The second is more detailed and is included for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for moist soil unless otherwise stated.

As mentioned in the section "How this survey was made," not all mapping units are members of a soil series. Riverwash, for example, does not belong to a soil series, but nevertheless, it is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and range site in which the mapping unit has been placed. The page where each capability unit and range site is described is listed in the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and

TABLE 1.—*Acreage and proportionate extent of the soils*

Map symbol	Soil name	Acres	Percent
100	Aiken loam, 2 to 15 percent slopes	2,780	0.6
101	Aiken loam, 15 to 30 percent slopes	1,950	0.4
102	Aiken loam, 30 to 50 percent slopes	5,165	1.1
103	Bale loam, 0 to 2 percent slopes	1,470	0.3
104	Bale clay loam, 0 to 2 percent slopes	11,950	2.5
105	Bale clay loam, 2 to 5 percent slopes	2,585	0.5
106	Bale complex, 0 to 2 percent slopes, seeped	350	0.1
107	Boomer loam, 2 to 15 percent slopes	1,320	0.3
108	Boomer gravelly loam, 15 to 30 percent slopes	1,290	0.3
109	Boomer gravelly loam, 30 to 50 percent slopes	8,745	1.8
110	Boomer-Forward-Felta complex, 5 to to 30 percent slopes	4,505	0.9
111	Boomer-Forward-Felta complex, 30 to 50 percent slopes	8,910	1.8
112	Bressa-Dibble complex, 5 to 15 percent slopes	2,810	0.6
113	Bressa-Dibble complex, 15 to 30 percent slopes	7,875	1.6
114	Bressa-Dibble complex, 30 to 50 percent slopes	62,370	12.8
115	Bressa-Dibble complex, 50 to 75 percent slopes	22,030	4.5
116	Clear Lake clay, drained	6,645	1.4
117	Clear Lake clay, overwashed	545	0.1
118	Cole silt loam, 0 to 2 percent slopes	8,360	1.7
119	Cole silt loam, 2 to 5 percent slopes	485	0.1
120	Contra Costa loam, 5 to 15 percent slopes	990	0.2
121	Contra Costa gravelly loam, 5 to 15 percent slopes	980	0.2
122	Coombs gravelly loam, 0 to 2 percent slopes	965	0.2
123	Coombs gravelly loam, 2 to 5 percent slopes	4,115	0.8
124	Cortina very gravelly loam, 0 to 5 percent slopes	1,945	0.4
125	Cortina very stony loam, 0 to 5 percent slopes	795	0.2
126	Diablo clay, 5 to 9 percent slopes	425	0.1
127	Diablo clay, 9 to 15 percent slopes	545	0.1
128	Diablo clay, 15 to 30 percent slopes	830	0.2
129	Diablo clay, 30 to 50 percent slopes	695	0.1
130	Egbert silty clay loam	1,260	0.3
131	Fagan clay loam, 5 to 15 percent slopes	1,640	0.3
132	Fagan clay loam, 15 to 30 percent slopes	2,290	0.5
133	Fagan clay loam, 30 to 50 percent slopes	1,915	0.4
134	Fagan clay loam, 30 to 50 percent slopes, slipped	5,265	1.1
135	Felton gravelly loam, 15 to 30 percent slopes	455	0.1
136	Felton gravelly loam, 30 to 50 percent slopes	5,340	1.1
137	Felton gravelly loam, 50 to 75 percent slopes	2,510	0.5
138	Forward gravelly loam, 2 to 9 percent slopes	675	0.1
139	Forward gravelly loam, 9 to 30 percent slopes	6,715	1.4
140	Forward gravelly loam, 30 to 75 percent slopes	18,665	3.8
141	Forward-Kidd complex, 50 to 75 percent slopes	6,775	1.4
142	Guenoc loam, 30 to 50 percent slopes	1,405	0.3
143	Guenoc-Rock outcrop complex, 5 to 30 percent slopes	3,645	0.8
144	Guenoc-Rock outcrop complex, 30 to 75 percent slopes	2,040	0.4
145	Haire loam, 0 to 2 percent slopes	1,420	0.3
146	Haire loam, 2 to 9 percent slopes	8,590	1.8
147	Haire clay loam, 0 to 2 percent slopes	1,070	0.2
148	Haire clay loam, 2 to 9 percent slopes	1,360	0.3
149	Haire clay loam, 9 to 15 percent slopes	605	0.1
150	Haire clay loam, 15 to 30 percent slopes	580	0.1
151	Hambright-Rock outcrop complex, 2 to 30 percent slopes	3,975	0.8
152	Hambright-Rock outcrop complex, 30 to 75 percent slopes	19,200	4.0
153	Henneke gravelly loam, 5 to 30 percent slopes	1,820	0.4
154	Henneke gravelly loam, 30 to 75 percent slopes	54,995	11.3
155	Kidd loam, 15 to 30 percent slopes	910	0.2
156	Kidd loam, 30 to 75 percent slopes	3,790	0.8
157	Lodo-Maymen-Felton association, 30 to 75 percent slopes	4,815	1.0
158	Los Gatos loam, 5 to 30 percent slopes	425	0.1
159	Los Gatos loam, 30 to 50 percent slopes	1,995	0.4
160	Los Gatos loam, 50 to 75 percent slopes	1,660	0.3
161	Maxwell clay, 2 to 9 percent slopes	3,330	0.7
162	Maymen-Los Gatos complex, 50 to 75 percent slopes	9,155	1.9
163	Maymen-Millsholm-Lodo association, 30 to 75 percent slopes	31,460	6.5
164	Millsholm loam, 15 to 30 percent slopes	1,280	0.3
165	Millsholm loam, 30 to 75 percent slopes	4,875	1.0
166	Montara clay loam, 5 to 30 percent slopes	4,290	0.9
167	Montara clay loam, 30 to 50 percent slopes	3,400	0.7
168	Perkins gravelly loam, 2 to 5 percent slopes	1,595	0.3
169	Perkins gravelly loam, 5 to 9 percent slopes	1,280	0.3
170	Pleasanton loam, 0 to 2 percent slopes	3,020	0.6
171	Pleasanton loam, 2 to 5 percent slopes	3,725	0.8
172	Reyes silty clay loam	6,800	1.4
173	Reyes silty clay loam, salt ponds	5,435	1.1
174	Riverwash	1,000	0.2
175	Rock outcrop	11,315	2.3
176	Rock outcrop-Hambright complex, 50 to 75 percent slopes	8,290	1.7
177	Rock outcrop-Kidd complex, 50 to 75 percent slopes	14,475	3.0
178	Sobrante loam, 5 to 30 percent slopes	3,120	0.6
179	Sobrante loam, 30 to 50 percent slopes	15,095	3.1
180	Tehama silt loam, 0 to 5 percent slopes	5,265	1.1
181	Yolo loam, 0 to 2 percent slopes	3,955	0.8
182	Yolo loam, 2 to 5 percent slopes	730	0.2
	Total	485,120	100.0

methods of soil mapping can be obtained from the Soil Survey Manual (*13*).[1]

Aiken series

The Aiken series consists of well drained soils on uplands. Slope is 2 to 50 percent. Elevation is 300 to 2,500 feet. These soils formed in material weathered from basic volcanic rock. The natural vegetation consists of ponderosa pine, oaks, redwoods in moist draws, annual grasses, and brush in small areas that had been cleared. The mean annual precipitation is 30 to 50 inches, and the mean annual temperature is 54° to 56° F. Summers are warm and dry, and winters moist and cool. The frost-free season is 200 to 250 days.

In a representative profile the surface layer is reddish brown, medium acid and slightly acid loam 8 inches thick. The subsoil is medium acid, reddish brown clay loam and medium acid, yellowish red clay 36 inches thick. Hard basic igneous rock is at a depth of 44 inches.

Permeability is moderately slow. The effective rooting depth is 40 to 60 inches or more. Available water capacity is 6.5 to 11 inches.

Aiken soils are mainly used for timber. A few areas that are gently sloping have been cleared and are used for vineyards and orchards.

Representative profile of Aiken loam, 2 to 15 percent slopes, 400 feet southwest from the southwest corner of the fence line of the air strip at Pacific Union College, SE¼SE¼ sec. 5, T. 8 N., R. 5 W.:

A11—0 to 2 inches, reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/3) moist; moderate fine and medium granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine common medium roots; few fine interstitial pores; medium acid (pH 6.0); clear smooth boundary.

A12—2 to 8 inches, reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium and few coarse roots; few fine common medium tubular pores; slightly acid (pH 6.2); abrupt wavy boundary.

B21t—8 to 14 inches, reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; weak coarse angular blocky structure; very hard, friable, sticky and plastic; few fine and medium and many coarse roots; many very fine and fine tubular and interstitial pores; few thin clay films on peds and lining pores; medium acid (pH 6.0); clear wavy boundary.

B22t—14 to 20 inches, yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; weak coarse angular blocky structure; very hard, firm, very sticky and plastic; many medium and common coarse roots; many very fine and fine tubular and interstitial pores; few thin clay films on peds and lining pores; medium acid (pH 6.0); gradual wavy boundary.

B23t—20 to 27 inches, yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; massive; very hard, firm, very sticky and plastic; few fine and medium roots; common very fine and fine tubular and interstitial pores; common thin clay films on peds and lining pores; medium acid (pH 6.0); diffuse wavy boundary.

B31t—27 to 35 inches, yellowish red (5YR 5/8) clay, yellowish red (5YR 4/8) moist; massive; very hard, firm, very sticky and plastic; few fine and medium roots; common very fine and fine tubular and interstitial pores; common thin clay films on peds and lining pores; medium acid (pH 6.0); diffuse wavy boundary.

B32t—35 to 44 inches, yellowish red (5YR 5/8) clay, yellowish red (5YR 4/8) moist; massive; hard, firm, very sticky and plastic; common very fine and fine tubular and interstitial pores; common thin clay films on peds and lining pores; medium acid (pH 6.0); abrupt irregular boundary.

R—44 inches, basic igneous bedrock.

The A horizon is dark reddish brown and reddish brown (5YR 3/3, 3/4, and 4/4) loam or clay loam. In some pedons it is gravelly and cobbly and is 15 to 30 percent fragments, by volume. Structure is fine and medium granular to weak and fine or medium subangular blocky.

The Bt horizon is strong brown, reddish brown, and yellowish red (7.5YR 5/6 and 4/6 and 5YR 4/4, 5/4, 5/6, 5/8, 7/6, and 6/6). Structure is weak, coarse, subangular blocky or angular blocky, or the soil is massive. Reaction is medium acid or strongly acid. Depth to hard igneous bedrock ranges from 40 to 60 inches.

The Aiken soils in Napa County are shallower to bedrock and are less acid than is defined in the range for the series. These differences, however, do not greatly alter the use and behavior of the soils.

100—Aiken loam, 2 to 15 percent slopes. This gently sloping to strongly sloping soil is mainly on foot slopes on uplands, but in places in the Los Posadas area it is on wide, mesalike areas. This soil has the profile described as representative of the series.

Included with this soil in mapping were small areas of Boomer, Forward, Kidd, and Sobrante soils. Also included were small areas of soils, along White Cottage Road, that formed in material weathered from serpentine, areas of soils that have stones on the surface, and areas of soils that are more than 60 inches deep to bedrock.

Runoff is medium, and the hazard of erosion is slight.

This soil is mainly used for timber and watershed. Small areas that are gently sloping are used for vineyards and orchards. Capability unit IIIe–1(5).

101—Aiken loam, 15 to 30 percent slopes. This moderately steep soil is on side slopes on uplands.

Included with this soil in mapping were small areas of Boomer, Felton, Forward, Kidd, and Sobrante soils,

[1] Italic numbers in parentheses refer to References, p. 101.

areas of soils that have stones on the surface, and areas of soils that are more than 60 inches deep to bedrock.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber, recreation, wildlife habitat, and watershed. Capability unit IVe–1(5).

102—Aiken loam, 30 to 50 percent slopes. This steep soil is on uplands.

Included with this soil in mapping were small areas of Boomer, Felton, Forward, Kidd, and Sobrante soils, areas of soils that have stones on the surface, and areas of soils that are similar to this Aiken soil but that are less than 40 inches deep to bedrock.

Runoff is rapid, and the hazard of erosion is moderate.

This soil is used for timber, recreation, wildlife habitat, and watershed. Capability unit VIe–1 (5).

Bale series

The Bale series consists of somewhat poorly drained soils on alluvial fans, flood plains, and low terraces. Slope is 0 to 5 percent. Elevation is 100 to 300 feet. These soils formed in alluvium derived from rhyolite and basic igneous rock. The plant cover is oak, blackberry, annual grasses, poison-oak, and willows. Mean annual precipitation is 25 to 35 inches. Mean annual air temperature is 58° to 61° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 270 days.

In a representative profile the surface layer is dark gray, slightly acid loam 6 inches thick. The subsoil is 18 inches thick. The upper 11 inches is grayish brown, slightly acid loam, and the lower 7 inches is brown, slightly acid loam. Between depths of 24 and 60 inches or more are stratified layers of gray and pale brown slightly acid loam, gravelly sandy loam, and sandy loam.

Permeability is moderate. Temporary ponding is common during periods of high rainfall. The effective rooting depth is 60 inches or more. The available water capacity is 6 to 9 inches.

Bale soils are used mainly for vineyards, but some small areas are used for irrigated pasture and prune orchards.

Representative profile of Bale loam, 0 to 2 percent slopes, 950 feet south of Silverado Trail from Picket Road and 100 feet west along vineyard, NE¼NE¼ sec. 6, T. 8 N., R. 6 W.:

Ap—0 to 6 inches, dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular and interstitial pores; 10 percent gravel; slightly acid (pH 6.3); clear smooth boundary.

B21—6 to 17 inches, grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few coarse and common fine roots; common medium and fine tubular and interstitial pores; 10 percent gravel; slightly acid (pH 6.3); clear smooth boundary.

B22—17 to 24 inches, brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine and fine tubular and interstitial pores; 10 percent gravel; slightly acid (pH 6.3); gradual smooth boundary.

A11b—24 to 33 inches, gray (10YR 5/1) loam, black (10YR 2/1) moist; moderate fine subangular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; few fine and coarse roots; few fine and very fine tubular and interstitial pores; common thin clay films on peds and in pores; slightly acid (pH 6.3); gradual smooth boundary.

A12b—33 to 44 inches, gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular and interstitial pores; slightly acid (pH 6.3); gradual smooth boundary.

IIC1—44 to 50 inches, pale brown (10YR 6/3) gravelly sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; hard, friable, nonsticky and nonplastic; many fine interstitial pores; 20 percent gravel; slightly acid (pH 6.3); clear smooth boundary.

IIIC2—50 to 60 inches, pale brown (10YR 6/3) sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; hard, friable, nonsticky and nonplastic; many fine interstitial pores; slightly acid (pH 6.3).

The Ap horizon is dark gray, very dark gray, grayish brown, or dark grayish brown (10YR 4/1, 3/1, 5/2, and 4/2) loam or clay loam. Structure is granular or subangular blocky. Reaction is mainly medium acid or slightly acid, but it is moderately alkaline in places.

The B2 horizon is dark grayish brown, grayish brown, dark brown, or brown (10YR 4/2, 5/2, 4/3, and 5/3) loam, gravelly heavy loam, clay loam, or gravelly clay loam. Gravel content is as much as 20 percent in some small areas. Structure is weak, fine or moderate, subangular blocky. Reaction is mainly medium acid, but it is moderately alkaline in places.

The B2 horizon is underlain by light gray to dark grayish brown (10YR 7/1, 7/3, 6/1, 6/2, 5/1, 5/2, 4/2, 6/3, and 5/3), stratified sandy loam, loam, or clay loam. Gravel content is 10 to 20 percent. Structure is granular or subangular blocky. Reaction is mainly medium acid or slightly acid, but it is moderately alkaline in places.

103—Bale loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans and flood plains. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Cole, Clear Lake, Cortina, and Yolo soils. Also included are areas of Bale soils near Calistoga that have a surface layer of gravelly loam.

Runoff is slow, and the hazard of erosion is slight. The water table is at a depth of more than 4 feet.

This soil is mainly used for vineyards. A few small areas that have not been drained are in pasture. Capability unit IIw–2 (14).

104—Bale clay loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans and flood plains. It has a profile similar to the one described as representative for the series, but the surface layer is clay loam.

Included with this soil in mapping were small areas of Clear Lake, Cole, and Yolo soils. Also included were areas of soils that have a hardpan at a depth of more than 40 inches.

Runoff is slow, and the hazard of erosion is slight. The water table is at a depth of more than 4 feet.

This soil is used mainly for vineyards. Capability unit IIw–2 (14).

105—Bale clay loam, 2 to 5 percent slopes. This gently sloping soil is on flood plains and low terraces. It has a profile similar to the one described as representative of the series, but the surface layer is clay loam.

Included with this soil in mapping were small areas of Cole, Cortina, and Yolo soils.

Runoff is slow, and the hazard of erosion is slight. The water table is at a depth of more than 4 feet.

Nearly all the acreage of this soil is used for vineyards. Capability unit IIw–2 (14).

106—Bale complex, 0 to 2 percent slopes, seeped. This complex consists of nearly level, stratified loam, clay loam, and gravelly loam.

Included with these soils in mapping were areas of slowly permeable soils that are stratified with clay.

Permeability is moderate, and runoff is slow. There is little or no hazard of erosion. The water table is at a depth of 2 to 4 feet. Reaction is neutral to moderately alkaline. Boron toxicity is strong.

These soils are not suited to cultivation because of the excessive boron content. Most areas are in saltgrass and star thistle. Capability unit VIIIw–1 (14, 15).

Boomer series

The Boomer series consists of well drained soils on uplands. Slope is 2 to 50 percent. Elevation is 500 to 2,500 feet. These soils formed in material weathered from mixed igneous rocks. The plant cover is Douglas-fir, ponderosa pine, black oak, manzanita, poison-oak, and madrone. The mean annual precipitation is 30 to 50 inches, and the mean annual temperature is 53° to 56° F. Summers are warm and dry, and winters are cool and moist. The frost-free season is 210 to 250 days.

In a representative profile a 2-inch-thick layer of duff and litter is on the surface. The mineral surface layer is brown, medium acid loam 4 inches thick. The subsoil is brown and yellowish red, slightly acid and medium acid clay loam 30 inches thick. The substratum is pink, slightly acid clay loam 10 inches thick. Very pale brown weathered andesite is at a depth of 44 inches.

Permeability is moderately slow. The effective rooting depth is 40 to 60 inches or more. Available water capacity is 6 to 10 inches.

Boomer soils are used mostly for timber. Some small areas are used for wildlife habitat and recreation.

Representative profile of Boomer loam, 2 to 15 percent slopes, 4,800 feet east of intersection of Howell Mountain Road and Los Posados Road and 90 feet south of Los Posados Road, SW¼SW¼ sec. 4, T. 8 N., R. 5 W.:

O1—2 inches to 0; duff and litter.

A1—0 to 4 inches; brown (7.5YR 5/4) loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; common very fine tubular and interstitial pores; medium acid (pH 6.0); gradual smooth boundary.

B1t—4 to 11 inches; brown (7.5YR 5/4) clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few coarse, common medium, and many very fine and fine tubular and interstitial pores; few thin clay films on peds and lining pores; medium acid (pH 6.0); gradual smooth boundary.

B21t—11 to 22 inches; yellowish red (5YR 5/6) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; few coarse and many very fine and fine roots; common very fine and fine tubular and interstitial pores; common thin clay films on peds and lining pores; slightly acid (pH 6.3); clear wavy boundary.

B22t—22 to 34 inches; yellowish red (5YR 5/6) and light brown (7.5YR 6/4) clay loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; common very fine and fine tubular and interstitial pores; few thin clay films on peds and in pores; slightly acid (pH 6.2); clear wavy boundary.

C1—34 to 44 inches; pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, sticky and slightly plastic; few coarse, very fine, and fine roots; common very fine and fine tubular and interstitial pores; few thin clay films in pores; slightly acid (pH 6.2); gradual irregular boundary.

Cr2—44 to 56 inches, very pale brown (10YR 7/4) weathered andesite.

The A1 horizon is brown (7.5YR 5/4 and 4/4) loam or gravelly loam. It is medium acid or slightly acid. In some pedons the A1 horizon is 15 to 20 percent pebbles 2 to 5 millimeters in diameter. It is less than 15 percent pebbles in pedons on foot slopes and plateaus.

The Bt horizon is brown or yellowish red (7.5YR 5/4, 4/4, and 5YR 5/6) clay loam or gravelly clay loam. In some pedons the Bt horizon is 15 to 20 percent pebbles 2 to 5 millimeters in diameter.

The C horizon is pale brown, very pale brown, or pink (10YR 7/3, 7/4, and 6/3 and 7.5YR 8/4 and 7/4). Depth to the Cr horizon is 40 to 60 inches.

Boomer soils in Napa County are less red than is defined in the range for the series. This difference, however, does not alter the use and management of the soils.

107—Boomer loam, 2 to 15 percent slopes. This gently sloping to strongly sloping soil is on foot slopes and plateaus on uplands. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Aiken, Forward, and Kidd soils.

Runoff is medium. The hazard of erosion is slight.

This soil is used for timber, recreation, and watershed. Capability unit IIIe–1 (5).

108—Boomer gravelly loam, 15 to 30 percent slopes. This moderately steep soil is on side slopes on uplands. It has a profile similar to the one described as representative of the series, but the profile is 15 to 20 percent pebbles 2 to 5 millimeters in diameter.

Included with this soil in mapping were small areas of Aiken, Forward, and Kidd soils. Also included were areas of soils that have stones on the surface and areas of Rock outcrop.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used mostly for timber and watershed. Capability unit IVe–1 (5).

109—Boomer gravelly loam, 30 to 50 percent slopes. This steep soil is on uplands. It has a profile similar to the one described as representative of the series, but the profile is 15 to 20 percent pebbles 2 to 5 millimeters in diameter.

Included with this soil in mapping were small areas of Aiken, Forward, and Kidd soils. Also included were areas of soils that have stones on the surface and areas of Rock outcrop.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used mostly for timber, wildlife habitat, and watershed. Capability unit VIe–1 (5).

110—Boomer-Forward-Felta complex, 5 to 30 percent slopes. The gently sloping to moderately steep soils of this complex are on uplands. These soils are so intermingled that it was not practical to separate them at the scale used in mapping. The Felta soils commonly occur in benchlike areas on side slopes.

This complex is about 40 percent Boomer soils, 35 percent Forward soils, and 20 percent Felta soils. The remaining 5 percent is small areas of dark red soils near Spring Mountain Road and Petrified Forest Road and areas of gray clayey soils that have gentler slopes. The Boomer and Forward soils in this complex have profiles similar to the ones described as representative of their respective series. A Felta soil in this complex has the profile described as representative of the Felta series.

Runoff is medium. The hazard of erosion is slight on the Boomer soils and moderate on the Forward and Felta soils.

The soils in this complex are used for timber, wildlife habitat, and watershed. Capability unit IVe–1 (5).

111—Boomer-Forward-Felta complex, 30 to 50 percent slopes. The steep soils of this complex are on uplands. The soils are so intermingled that it was not practical to separate them at the scale used in mapping. The Felta soils commonly occur on south-facing side slopes.

This complex is about 45 percent Boomer soils, 35 percent Forward soils, and 15 percent Felta soils. The remaining 5 percent is small areas of dark red soils near Spring Mountain Road and Petrified Forest Road and areas of gray clayey soils that have gentler slopes.

Runoff is rapid. The hazard of erosion is slight on the Boomer soils and severe on the Forward and Felta soils.

The soils in this complex are used for timber, wildlife habitat, and watershed. Capability unit VIe–1 (5).

Bressa series

The Bressa series consists of well drained soils on uplands. Slope is 5 to 75 percent. Elevation is 400 to 2,000 feet. These soils formed in material weathered from sandstone and shale. The plant cover is mostly annual grasses and scattered oaks. The mean annual precipitation is 25 to 35 inches. The mean annual air temperature is 62° to 64° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is pale brown, slightly acid silt loam 10 inches thick. The subsoil is light yellowish brown and yellowish brown, slightly acid and medium acid silty clay loam 23 inches thick. Weathered, soft sandstone is at a depth of 33 inches.

Permeability is moderately slow. The effective rooting depth is 30 to 40 inches, and the available water capacity is 4 to 6 inches.

Bressa soils are used mostly for range. Some areas near Lake Berryessa are used for recreation.

Representative profile of Bressa silt loam, in an area of Bressa-Dibble complex, 30 to 50 percent slopes, 1 mile north on Gordon Valley Road from intersection with Wooden Valley cross road, about 100 feet north on road from cattle guard, and 150 feet east of road on hillside, NE¼SW¼ sec. 19 (projected), T. 6 N., R. 2 W.:

A11—0 to 4 inches, pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; slightly acid (pH 6.5); clear smooth boundary.

A12—4 to 10 inches, pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; slightly acid (pH 6.5); clear smooth boundary.

B1t—10 to 15 inches, light yellowish brown (10YR 6/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine roots; many fine tubular and interstitial pores; few thin clay films on peds and lining pores;

slightly acid (pH 6.5); clear smooth boundary.

B2t—15 to 23 inches, yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common very fine and few coarse roots; many fine tubular and interstitial pores; many moderately thick clay films on peds, lining pores, and as bridges; medium acid (pH 5.6); gradual smooth boundary.

B3t—23 to 33 inches, yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; many fine tubular and interstitial pores; many moderately thick clay films on peds, lining pores, and as bridges; medium acid (pH 5.6); gradual irregular boundary.

Cr—33 to 37 inches, soft weathered sandstone and some soil material.

The A horizon is light brownish gray, pale brown, or light yellowish brown (10YR 6/2, 6/3, and 6/4) silt loam, loam, or sandy loam. Reaction is slightly acid or neutral.

The Bt horizon is brown, dark yellowish brown, light yellowish brown, or yellowish brown (10YR 4/3, 4/4, 6/4, and 5/4) clay loam or silty clay loam. Reaction is medium acid to neutral. Depth to weathered sandstone or shale ranges from 30 to 40 inches.

The Cr horizon is weathered sandstone or shale. Soil material from the A and B horizons is mixed in places in the upper 6 inches of this horizon.

Bressa soils are mapped only in complex with Dibble soils.

112—Bressa-Dibble complex, 5 to 15 percent slopes. This complex consists of gently sloping to strongly sloping soils on uplands. These soils are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 60 percent Bressa soils, 25 percent Dibble soils, and 15 percent Contra Costa, Maymen, Millsholm, and Sobrante soils and an inextensive clayey soil.

Runoff is medium. The hazard of erosion is slight.

These soils are mainly used for range. A small acreage is used for vineyards. Capability unit IIIe–1 (15); Fine Loamy range site.

113—Bressa-Dibble complex, 15 to 30 percent slopes. This complex consists of moderately steep soils on narrow ridgetops that are on uplands. These soils formed in material weathered from sandstone and shale, and they are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 70 percent Bressa soils, 20 percent Dibble soils, and 10 percent Maymen, Contra Costa, Lodo, Millsholm, and Sobrante soils. The Dibble soil has the profile described as representative of the Dibble series.

Runoff is medium. The hazard of erosion is slight to moderate.

These soils are mainly used for grazing. Some areas near Lake Berryessa are used for homesites and recreation. Capability unit IVe–1 (15); Fine Loamy range site.

114—Bressa-Dibble complex, 30 to 50 percent slopes. This complex consists of steep soils on uplands at an elevation of 1,000 to 2,000 feet. These soils formed in material weathered from sandstone and shale, and they are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 65 percent Bressa soils, 20 percent Dibble soils, and 15 percent Lodo, Los Gatos, Maymen, Millsholm, Montara, and Sobrante soils and a small acreage of a clayey soil. The Bressa soil has the profile described as representative of the Bressa series.

Runoff is rapid. The hazard of erosion is moderate to severe.

These soils are used mostly for grazing. Capability unit VIe–1 (15); Fine Loamy range site.

115—Bressa-Dibble complex, 50 to 75 percent slopes. This complex consists of very steep soils on side slopes and narrow ridgetops on uplands. These soils are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 70 percent Bressa soils, 15 percent Dibble soils, and 15 percent Lodo, Los Gatos, Maymen, Millsholm, and Sobrante soils, an inextensive clayey soil, and areas of severely eroded soils.

Runoff is rapid to very rapid. The hazard of erosion is moderate to high. The rooting depth is shallow in the areas of severely eroded soils.

These soils have limited use for grazing. Areas that are inaccessible to livestock are used for wildlife habitat and watershed. Capability unit VIIe–1 (15); Fine Loamy range site.

Clear Lake Series

The Clear Lake series consists of poorly drained soils on old alluvial fans and in basins. Slope is 0 to 2 percent. Elevation is 30 to 250 feet. These soils formed in alluvium derived from sedimentary rock. The plant cover is annual grasses and forbs and scattered oaks. The mean annual precipitation is 25 to 30 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is very dark gray, slightly acid to mildly alkaline clay 46 inches thick. The underlying material is light olive brown, moderately alkaline clay to a depth of 69 inches or more.

Permeability is slow. The water table is generally at a depth of more than 5 feet during the growing season, but it is as high as 3 feet in places. The effective rooting depth is more than 60 inches. Available water capacity is 8 to 10 inches.

Clear Lake soils are used mainly for annual pasture. Some areas are used for tomatoes and vineyards. Areas that are north of the Solano County line are used for urban development, but in places foundation and road stabilization is a major concern for this use.

Representative profile of Clear Lake clay, drained, about 300 feet south of American Canyon Road and 1,450 feet west of Flosden Road, NW¼SW¼ sec. 30, T. 4 N., R. 3 W.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak very coarse prismatic structure; very hard, extremely firm, very sticky and very plastic; many very fine and fine roots; common very fine pores; slightly acid (pH 6.2); abrupt smooth boundary.

A12—8 to 32 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak very coarse prismatic structure; very hard, extremely firm, very sticky and very plastic; many very fine and fine roots; many very fine pores; common slickensides; neutral (pH 7.0); gradual wavy boundary.

A13—32 to 46 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak very coarse prismatic structure; very hard, extremely firm, very sticky and very plastic; common very fine and fine roots; few very fine pores; common slickensides; mildly alkaline (pH 7.8); clear smooth boundary.

Cca—46 to 69 inches, light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; massive; very hard, extremely firm, very sticky and very plastic; few fine roots; few very fine pores; moderately alkaline (pH 8.0) and strongly effervescent; lime in seams.

The A horizon is clay or clay loam. Structure is weak to strong angular blocky to moderate or weak prismatic. Reaction is slightly acid to mildly alkaline. When dry, this soil develops cracks 1 to 4 inches wide that extend into the C horizon. The lower part of the A horizon has common to many intersecting slickensides.

The C horizon ranges from light olive brown to dark grayish brown (2.5Y 5/4, 5/6, and 4/2). It has many distinct blotches of segregated lime.

116—Clear Lake clay, drained. This nearly level soil is on old alluvial fans and in basins. It has the profile described as representative of the series.

Included with this soil in mapping were areas of Bale, Haire, Cole, Reyes, Tehama, and Yolo soils and areas of soils that have slopes of 2 to 5 percent on basin rims and in narrow drainageways in the southern part of the county. Also included were areas of very dark grayish brown clayey soils near Green Island, small areas of lime-free clay in the northern part of Napa Valley, and a few areas of soils that have a water table at a depth of 5 feet or less.

Runoff is slow or very slow. These is little or no hazard of erosion. The upper few inches of this soil commonly becomes strongly granular upon drying.

This soil is mainly used for pasture. Some areas in the northern part of Napa Valley are used for vineyards. Capability unit IIs–5 (14).

117—Clear Lake clay, overwashed. This nearly level soil has a profile similar to the one described as representative of the series, but an overwash of grayish brown fine sandy loam 12 to 18 inches thick overlies the clay surface layer.

Included with this soil in mapping were small areas of soils that are covered by an overwash 20 to 40 inches thick. Also included were small areas of Bale and Yolo soils and areas of well drained soils.

This soil is subject to annual and periodic flooding and subsequent removal and deposition of coarse textured surface material. The water table is between depths of 3 and 6 feet during winter.

This soil is mainly used for irrigated pasture, but much of the acreage is being converted to vineyards. Capability unit IIIw–5 (14).

Cole series

The Cole series consists of somewhat poorly drained soils on alluvial fans and flood plains. Slope is 0 to 5 percent. Elevation is 100 to 300 feet. These soils formed in aluvium weathered from sandstone, shale, and basic rock. The plant cover is oak and native grasses. Mean annual precipitation is 25 to 30 inches. The mean annual temperature is 58° to 60° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is grayish brown, slightly acid silt loam about 8 inches thick. The subsoil is dark gray, neutral to mildly alkaline silty clay loam in the upper 24 inches and grayish brown, mildly alkaline silty clay loam in the lower 9 inches. The substratum to a depth of 64 inches or more is grayish brown and light yellowish brown, moderately alkaline clay loam and clay and is mottled at a depth of more than 48 inches.

Permeability is moderately slow. The effective rooting depth is 60 inches or more. The available water capacity is 10 to 12 inches.

Cole soils are mainly used for vineyards. Some areas are used for irrigated pasture and prune and pear orchards.

Representative profile of Cole silt loam, 0 to 2 percent slopes, 1,000 feet south of the intersection of Skellinger Lane and Ponti Drive, T. 7 N., R. 5 W. (nonsectionalized):

Ap—0 to 8 inches, grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; many very fine and common medium roots; many very fine and fine tubular and interstitial pores; slightly acid (pH 6.5); clear smooth boundary.

B1t—8 to 18 inches, dark gray (10YR 4/1) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium and coarse subangular blocky and weak medium prismatic structure; very hard, firm, slightly sticky and slightly plastic; many very fine and few medium roots; many very fine and fine tubular and interstitial pores; few thin clay films on peds and lining pores; neutral (pH 7.0); diffuse wavy boundary.

B21t—18 to 32 inches, dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium and coarse and weak medium prismatic structure; very hard, firm, slightly sticky and plastic; many very fine

roots; common very fine and fine tubular and interstitial pores; few thin clay films on peds and lining pores; mildly alkaline (pH 7.5); diffuse smooth boundary.

B22t—32 to 41 inches, grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate coarse subangular blocky structure and weak medium prismatic; very hard, firm, slightly sticky and plastic; common very fine roots; common very fine and few fine interstitial pores; few thin clay films on peds and lining pores; mildly alkaline (pH 7.5); gradual smooth boundary.

C1—41 to 48 inches, grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse subangular blocky structure and weak coarse prismatic; very hard, firm, sticky and plastic; common very fine roots; common very fine tubular and interstitial pores; few moderately thick clay films on peds and in pores; moderately alkaline (pH 8.0); gradual smooth boundary.

C2—48 to 60 inches, grayish brown (2.5Y 5/2) clay and few fine faint light yellowish brown (2.5Y 6/4) mottles, dark grayish brown (2.5Y 4/2) moist; moderate coarse subangular blocky structure and weak coarse prismatic; very hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; few moderately thick clay films on peds, lining pores, and as bridges; moderately alkaline (pH 8.0); gradual smooth boundary.

C3—60 to 64 inches, light yellowish brown (10YR 6/4) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; few moderately thick clay films lining pores and as bridges; moderately alkaline (pH 8.0).

The Ap horizon ranges from dark grayish brown to brown (4/2, 4/3, 5/2, and 5/3) and has hue of 10YR and 2.5Y. It is silt loam to silty clay loam. Structure ranges from moderate to weak subangular blocky. Reaction is slightly acid or neutral.

The Bt horizon ranges from dark gray to grayish brown (4/1, 4/2, 5/1, and 5/2) in hue of 10YR and 2.5Y. It is silty clay loam or silty clay.

The C horizon ranges from grayish brown to olive and has hue of 10YR, 2.5Y and 5Y. Reaction is mildly alkaline or moderately alkaline, but the horizon is not calcareous.

118—Cole silt loam, 0 to 2 percent slopes. This nearly level soil is in large areas on old alluvial fans and flood plains. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bale, Clear Lake, Cortina, and Yolo soils. Also included were areas of soils that are similar to this Cole soil except that the subsoil is calcareous.

Runoff is very slow. There is little or no hazard of erosion. The water table is at a depth of 3 to 5 feet in places late in winter and early in spring in years that have heavy rainfall.

This soil is used for vineyards, prune orchards, and irrigated pasture, but the orchards and pastures are being converted to vineyards. Capability unit IIw–2 (14).

119—Cole silt loam, 2 to 5 percent slopes. This gently sloping soil is on old alluvial fans and flood plains.

Included with this soil in mapping were small areas of Bale, Clear Lake, Cortina, and Yolo soils. Also included were areas of soils that are similar to this Cole soil except that the subsoil is calcareous.

Runoff is slow or very slow. There is little or no hazard of erosion. The water table is at a depth of 3 to 5 feet in places late in winter and early in spring in years that have heavy rainfall.

This soil is used for vineyards, prune orchards, and irrigated pasture. Capability unit IIw–2 (14).

Contra Costa series

The Contra Costa series consists of well drained soils on benchlike areas on uplands. Slope is 5 to 15 percent. Elevation is 400 to 2,000 feet. These soils formed in material weathered from sandstone. The plant cover is mostly annual grasses and scattered oaks. The mean annual precipitation is 25 to 35 inches, and the mean annual temperature is 61° to 64° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is brown, neutral loam about 5 inches thick. The subsoil is brown, neutral clay loam and clay 29 inches thick. Fractured and weathered shale and sandstone are at a depth of 34 inches.

Permeability is slow. The effective rooting depth is 25 to 40 inches. The available water capacity is 5 to 8 inches.

Contra Costa soils are used for grazing and for recreation where they are adjacent to resort areas.

Representative profile of Contra Costa loam, 5 to 15 percent slopes, about 4.5 miles south of turnoff of Knoxville Road and ranch road adjacent to each side of Lake Berryessa, north of western edge of Tin Can Canyon, T. 8 N., R. 3 W. (nonsectionalized):

A1—0 to 5 inches, brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine tubular and interstitial pores; neutral (pH 7.3); clear wavy boundary.

B21t—5 to 11 inches, brown (7.5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine tubular and interstitial pores; common thin clay films on peds; neutral (pH 7.3); gradual wavy boundary.

B22t—11 to 22 inches, brown (7.5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong coarse angular blocky structure; very hard, firm, sticky and plastic; common few fine

roots; few fine tubular pores; common moderately thick clay films on peds and lining pores; neutral (pH 7.2); clear smooth boundary.

B3t—22 to 34 inches, brown (7.5YR 4/4) shaly clay, dark reddish brown (5YR 3/4) moist; moderate coarse angular blocky structure; very hard, firm, sticky and plastic; very few fine and fine roots; few tubular pores; common moderately thick clay films on peds, lining pores, and as bridges; neutral (pH 7.2); clear smooth boundary.

Cr—34 to 38 inches, yellowish brown (10YR 5/4) fractured and shattered shale.

The A horizon is grayish brown, yellowish brown, or brown (10YR 5/2 and 5/4 and 7.5YR 5/2, 5/4, and 4/4) loam or clay loam. Reaction is slightly acid or neutral. In some areas in Pope Valley, the A horizon is 15 to 25 percent gravel.

The Bt horizon is reddish brown or brown (7.5YR 5/4 and 4/4 and 5YR 5/4 and 4/4). Reaction is slightly acid or neutral. In some pedons the lower part of the Bt horizon is shaly clay derived from fractured sedimentary bedrock. Fractured and weathered sandstone and shale are at a depth of 25 to 40 inches.

120—Contra Costa loam, 5 to 15 percent slopes. This moderately sloping and strongly sloping soil is in benchlike areas on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bressa, Dibble, Sobrante, and Tehama soils.

Runoff is medium. The hazard of erosion is slight.

This soil is mainly used for grazing. Some of the areas adjacent to Lake Berryessa are used for recreation. Capability unit IVe–3 (15); Fine Loamy range site.

121—Contra Costa gravelly loam, 5 to 15 percent slopes. This moderately sloping and strongly sloping soil is in benchlike areas on uplands mainly in the Pope Valley area. It has a profile similar to the one described as representative for the series, but the profile is 15 to 20 percent gravel.

Included with this soil in mapping were small areas of Bressa, Dibble, and Sobrante soils.

Runoff is medium. The hazard of erosion is slight.

This soil is used for grazing. Capability unit IVe–3 (15); Fine Loamy range site.

Coombs series

The Coombs series consists of well drained soils on terraces. Slope is 0 to 5 percent. Elevation is 100 to 500 feet. These soils formed in mixed alluvium derived from igneous and sedimentary rock. The native vegetation consists of annual grasses and forbs and scattered oak trees. The mean annual precipitation is 24 to 30 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is brown and pale brown, medium acid gravelly loam and clay loam about 13 inches thick. The subsoil is brown, light brown, and pink, strongly acid clay loam 41 inches thick. The substratum to a depth of more than 60 inches is very gravelly loamy fine sand.

Permeability is moderately slow. The effective rooting depth is 40 to 60 inches. Available water capacity is 6 to 10 inches.

Coombs soils are used mostly for prune orchards, but these orchards are being converted to vineyards. Small areas are used for irrigated pasture. Much of the area of these soils is being converted to urban uses.

Representative profile of Coombs gravelly loam, 2 to 5 percent slopes, about 2,400 feet south on Big Ranch Road from intersection of Salvador Avenue and 100 feet east of Big Ranch Road, NW¼NW¼ sec. 27, T. 6 N., R. 4 W.:

Ap—0 to 4 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; fine and coarse subangular blocky structure; hard, friable, nonsticky and slightly plastic; few very fine roots; 20 percent gravel; medium acid (pH 6.0); abrupt wavy boundary.

A3—4 to 13 inches, pale brown (10YR 6/3) clay loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; medium acid (pH 6.0); clear smooth boundary.

B1t—14 to 25 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine and few fine tubular pores; many thin clay films on peds and lining tubular pores; strongly acid (pH 5.5); clear smooth boundary.

B21t—25 to 35 inches, light brown (7.5YR 6/4) clay loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; few very fine roots; many very fine and few fine tubular pores; many thin clay films on peds and in pores; strongly acid (pH 5.5); clear smooth boundary.

B22t—35 to 43 inches, light brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and plastic; few very fine roots; few fine tubular pores; many thin clay films lining tubular pores; strongly acid (pH 5.5); clear smooth boundary.

B3t—43 to 54 inches, pink (7.5YR 7/4) clay loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and plastic; few fine tubular pores; many thin clay films lining pores; strongly acid (pH 5.3); clear smooth boundary.

IIC—54 to 60 inches, very gravelly loamy fine sand; few very fine roots; 85 percent gravel; strongly acid (pH 5.2).

The A horizon is mainly pale brown or brown (10YR 5/3 and 6/3 and 7.5YR 5/4) gravelly loam or gravelly clay loam, but it is heavy loam or heavy clay loam in some places.

The Bt horizon is mainly light yellowish brown to pink (10YR 5/3, 5/4, 6/3, 6/4, 7/3, and 7/4 and 7.5YR 5/4, 6/4, and 7/4) clay loam, but it is clay in places at a depth of more than 33 inches. Reaction is medium acid. Depth to the very gravelly substratum is 40 to 60 inches.

122—Coombs gravelly loam, 0 to 2 percent slopes. This nearly level soil is on old low terraces and old alluvial fans.

Included with this soil in mapping were small areas of Clear Lake, Haire, Bale, and Yolo soils and a reddish soil that has a heavy clay subsoil. Also included were areas of soils that have a semicemented conglomerate below the subsoil and areas of soils near Hagen Road that are underlain by rhyolytic tuff.

Runoff is slow. The hazard of erosion is slight.

This soil is mainly used for prune orchards, but the orchards are being converted to vineyards. Capability unit IIIs–3 (14).

123—Coombs gravelly loam, 2 to 5 percent slopes. This gently sloping soil is on old terraces and old alluvial fans. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of soils that have slopes of as much as 9 percent and small areas of Clear Lake, Cole, Haire, and Yolo soils. Also included were few small areas of a soil in the Big Ranch Road area that have a red clay subsoil and areas of soils near Hagen Road that are underlain by rhyolytic tuff.

Runoff is slow. The hazard of erosion is slight.

This soil is mainly used for prune orchards, but it is being converted to vineyards. Much of the area is used for homesites. Capability unit IIIe–3 (14).

Cortina series

The Cortina series consists of excessively drained soils on flood plains and alluvial fans. Slope is 0 to 5 percent. Elevation is 100 to 500 feet. These soils formed from recent stratified alluvium. The vegetation consists of willows and water grasses. The mean annual precipitation is 30 to 35 inches, and the mean annual temperature is 61° to 64° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 230 to 260 days.

In a representative profile the surface layer is about 21 inches thick. It is pale brown, neutral very gravelly loam in the upper 11 inches and light brownish gray, mildly alkaline very gravelly sandy loam in the lower 10 inches. The underlying material to a depth of 60 inches or more is stratified, light brownish gray, mildly alkaline very gravelly loamy sand.

Permeability is rapid. The effective rooting depth is 60 inches or more. Available water capacity is 2 to 5 inches.

Cortina soils are used mostly for vineyards. Some areas are used for prune orchards.

Representative profile of Cortina very gravelly loam, 0 to 5 percent slopes, 50 feet south of intersection of Silverado Trail and State Highway 128, SE¼NW¼ sec. 3, R. 5 W., T. 7 N.:

Ap—0 to 11 inches, pale brown (10YR 6/3) very gravelly loam, dark grayish brown (10YR 4/2) moist; massive; soft, friable, nonsticky and nonplastic; many very fine roots; many very fine and fine interstitial pores; 50 percent gravel; neutral (pH 7.0); clear smooth boundary.

A12—11 to 21 inches, light brownish gray (10YR 6/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, friable, nonsticky and nonplastic; many very fine roots; many very fine and fine interstitial pores; 50 percent gravel; mildly alkaline (pH 7.5); clear wavy boundary.

IIC1—21 to 32 inches, light brownish gray (10YR 6/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; massive; soft, friable, nonsticky and nonplastic; many very fine and few medium roots; many very fine and fine interstitial pores; 70 percent gravel; mildly alkaline (pH 7.5); clear wavy boundary.

IIC2—32 to 60 inches; light brownish gray (10YR 6/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; massive; soft, friable, nonsticky and nonplastic; many very fine and few medium roots; many very fine and fine interstitial pores; 80 percent gravel; mildly alkaline (pH 7.5).

The A horizon is pale brown, brown, light brownish gray, grayish brown, or dark grayish brown (10YR 6/3, 6/2, 5/2, 5/3, and 4/2) very gravelly sandy loam, very gravelly loam, or very stony loam. Reaction is slightly acid to mildly alkaline. The gravel content ranges from 50 to 60 percent.

The IIC horizon is light brownish gray or brown (10YR 6/2 and 5/3) very gravelly loamy sand or very stony loam. Reaction is slightly acid to moderately alkaline. The coarse-fragment content ranges from 50 to 90 percent.

124—Cortina very gravelly loam, 0 to 5 percent slopes. This nearly level to gently sloping soil is on flood plains. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bale and Yolo soils and areas of gravel deposits adjacent to waterways.

Runoff is slow. The hazard of erosion is slight.

This soil is used for vineyards and orchards. Capability unit IVs–4 (14).

125—Cortina very stony loam, 0 to 5 percent slopes. This nearly level to gently sloping soil is on alluvial fans. It has a profile similar to the one described as representative for the series, but stones larger than 10 inches are throughout the profile.

Included with this soil in mapping were small areas of of Bale and Yolo soils and Riverwash.

Runoff is slow. The hazard of erosion is slight.

This soil is mainly used for pasture. Some of the acreage is being converted to vineyards. Capability unit IVs–4 (14).

Diablo series

The Diablo series consists of well drained soils on uplands. Slope is 5 to 50 percent. Elevation is 50 to 1,500 feet. These soils formed in material weathered from sandstone and shale. The plant cover is mostly annual grasses and scattered oaks. The mean annual precipitation is 25 to 30 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is dark gray and very dark gray, acid clay 25 inches thick. The underlying material is calcerous clay 35 inches thick. It is light olive brown in the upper 12 inches and light yellowish brown in the lower 23 inches. Weathered sandstone and shale are at a depth of 60 inches.

Permeability is slow. The effective rooting depth is 40 to 80 inches. Available water capacity is 6 to 10 inches.

Diablo soils are mainly used for range and pasture. A few small areas on the lower slopes are used for vineyards.

Representative profile of Diablo clay, 15 to 30 percent slopes, about 1,500 feet south of intersection of State Highways 12 and 121 and Duhig Road, NE¼NE¼ sec. 23, T. 5 N., R. 4 W.:

A11—0 to 6 inches, dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate coarse subangular blocky structure; extremely firm, very sticky and very plastic; many very fine roots; many fine interstitial pores; slightly acid (pH 6.2); clear smooth boundary.

A12—6 to 25 inches, very dark gray (10YR 3/1) clay, very dark grayish brown (2.5Y 3/2) moist; weak very coarse prismatic structure; extremely hard, extremely firm, very sticky and very plastic; many coarse slickensides; many very fine roots; many fine interstitial pores; slightly acid (pH 6.2); clear wavy boundary.

C1ca—25 to 37 inches, light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 3/4 moist); weak very coarse angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; many medium slickensides; common very fine roots; common fine interstitial pores; violently effervescent lime in segregations; moderately alkaline (pH 8.0); gradual smooth boundary.

C2—37 to 60 inches, light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; weak very coarse angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few fine roots; few fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cr3—60 to 64 inches, light yellowish brown (2.5Y 6/4) fractured soft fine-grained sandstone.

The A horizon is mainly dark gray or very dark gray (10YR 4/1 and 3/1, N 4/, and N 3/) clay, but it is clay loam in some pedons. Reaction is slightly acid to mildly alkaline. When dry, this soil develops cracks 1 to 4 inches wide that extend into the C horizon. The lower part of the A horizon also has common to many intersecting slickensides.

The C horizon ranges from light yellowish brown to dark grayish brown (2.5Y, 6/4, 5/4, 5/2, and 4/2) clay or light clay. Reaction is moderately alkaline. The C horizon is generally calcareous and has lime disseminated in soft masses and seams and in places as concretions. Depth to weathered sandstone or shale ranges from 40 to 80 inches.

126—Diablo clay, 5 to 9 percent slopes. This moderately sloping soil is on footslopes on uplands.

Included with this soil in mapping were small areas of Dibble, Fagan, and Haire soils. Also included were areas of soils that are simliar to this Diablo soil but that are dark grayish brown.

Runoff is slow. The hazard of erosion is slight.

This soil is mainly used for range and pasture. Some small areas are used for varietal vineyards. Capability unit IIe–5 (15); Clayey range site.

127—Diablo clay, 9 to 15 percent slopes. This strongly sloping soil is on footslopes on uplands.

Included with this soil in mapping were small areas of Dibble, Fagan, and Haire soils. Also included are areas of soils that are similar to this Diablo soil but that are dark grayish brown.

Runoff is medium. The hazard of erosion is moderate.

This soil is used for range and pasture. Capability unit IIIe–5 (15); Clayey range site.

128—Diablo clay, 15 to 30 percent slopes. This moderately steep soil is on side slopes on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Fagan, Haire, and Millsholm soils.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used for range and pasture. Landslips and road stabilization are serious problems in developing some sites. Capability unit IVe–5 (15); Clayey range site.

129—Diablo clay, 30 to 50 percent slopes. This steep soil is on uplands.

Included with this soil in mapping were small areas of Dibble, Fagan, and Millsholm soils. Also included were areas of Diablo soils that have gullies and landslips.

Runoff is rapid. The hazard of erosion is moderate to high.

This soil is used as range and watershed. Landslips and road stabilization are serious problems in developing some sites. Capability unit VIe–1 (15); Clayey range site.

Dibble series

The Dibble series consists of well drained soils on uplands. Slope is 5 to 75 percent. Elevation is 200 to 2,000 feet. These soils formed in material weathered from sandstone and shale. The vegetation is mostly annual grasses and scattered oaks. The mean annual precipitation is 25 to 35 inches, and the mean annual temperature is 62° to 64° F. Summers are hot and

dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is pale brown and brown, slightly acid silty clay loam 9 inches thick. The subsoil is brown and yellowish brown, slightly acid silty clay and clay 25 inches thick. Weathered sandstone is at a depth of 34 inches.

Permeability is slow. The effective rooting depth is 20 to 40 inches. Available water capacity is 5 to 7 inches.

Dibble soils are used mostly for range. Some areas in the vicinity of Lake Berryessa are used for recreation.

Representative profile of Dibble silty clay loam, in an area of Bressa-Dibble complex, 15 to 30 percent slopes, 6,000 feet west on Partrick Road from intersection with Browns Valley Road and 900 feet north of Partrick Road in an ornamental eucalyptus orchard, T. 6 N., R. 5 W.:

A11—0 to 4 inches, pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common, very fine roots; common very fine tubular pores; slightly acid (pH 6.5); clear wavy boundary.

A12—4 to 9 inches, brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many, very fine roots; common very fine tubular pores; slightly acid (pH 6.5); clear wavy boundary.

B1t—9 to 14 inches, brown (10YR 5/3) silty clay, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; many thin clay films on peds; slightly acid (pH 6.2); clear smooth boundary.

B2t—14 to 34 inches, yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; strong coarse angular blocky structure; hard, very firm, sticky and very plastic; common very fine roots; common very fine tubular pores; continuous moderately thick clay films lining pores and on peds; slightly acid (pH 6.2); clear wavy boundary.

Cr—34 to 39 inches, shattered and weathered yellowish brown (10YR 5/6) sandstone mixed with clay that has white granular coatings.

The A horizon is light brownish gray, pale brown, brown, or yellowish brown (10YR 5/3, 6/2, 6/3, and 6/4) silt loam, loam, or silty clay loam.

The Bt horizon is brown, dark yellowish brown, light yellowish brown or yellowish brown (10YR 5/3, 6/4, 5/4, and 4/4). Reaction is slightly acid or neutral. Depth to weathered sandstone is 20 to 40 inches.

The Dibble soils are mapped only in complexes with Bressa soils.

Egbert series

The Egbert series consists of poorly drained soils in basins and on alluvial fans. Slope is 0 to 2 percent. Elevation is 15 to 30 feet. These soils formed in mixed alluvium. The vegetation is mostly annual grasses and scattered oaks and hay in cultivated fields. The mean annual precipitation is 24 to 30 inches, and the mean annual temperature is 60° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile, the surface layer is gray, light brownish gray, and grayish brown, neutral and moderately alkaline silty clay loam 19 inches thick. The underlying material is dark gray and gray, moderately alkaline clay to a depth of 60 inches and more.

Permeability is slow. The effective rooting depth is more than 60 inches. Available water capacity is 8 to 12 inches.

Egbert soils are used mostly for hay. Some areas are used for orchards and vineyards.

Representative profile of Egbert silty clay loam, 1,800 feet south of Imola Avenue and Southern Pacific Railroad and 500 feet east of railroad track, T. 5 N., R. 4 W. (nonsectionalized):

Ap—0 to 11 inches, gray and light brownish gray (10YR 6/1, 6/2) silty clay loam and few fine distinct dark brown (7.5YR 4/4) mottles, very dark grayish brown (10YR 3/4) and few distinct dark yellowish brown (10YR 3/4) mottles moist; weak medium subangular blocky structure (cloddy); very hard, friable, sticky and plastic; few medium and many very fine and fine roots; many medium and fine tubular and vesicular pores; neutral (pH 7.0); abrupt smooth boundary.

A12—11 to 19 inches, gray and grayish brown (10YR 5/1, 5/2) silty clay loam and many medium district brown (7.5YR 4/4) mottles, very dark gray (10YR 3/1) and many medium distinct strong brown (7.5YR 5/6) mottles moist; moderate coarse subangular blocky structure; very hard, firm, sticky and plastic; many fine and very fine roots; many fine and very fine tubular pores; moderately alkaline (pH 8.0); clear smooth boundary.

C1g—19 to 33 inches, dark gray and gray (10YR 4/1, 5/1) silty clay loam and many medium distinct brown (7.5YR 4/4) mottles, black (10YR 2/1) and many medium distinct brown (7.5YR 4/4) mottles moist; massive; very hard, firm, sticky and plastic; many fine and very fine roots; common very fine and fine tubular and interstitial pores; few thin clay films lining pores and as bridges; salt crystals; moderately alkaline (pH 8.0); clear smooth boundary.

C2g—33 to 48 inches, dark gray and gray (10YR 4/1, 5/1) clay and many medium distinct brown (7.5YR 4/4) mottles, black (10YR 2/1) and very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) mottles moist; massive; very hard, firm, slightly sticky and plastic; few very fine

roots; common very fine and fine tubular and interstitial pores; continuous, moderately thick clay films lining pores and as bridges; salt crystals; moderately alkaline (pH 8.0); gradual smooth boundary.

C3g—48 to 60 inches, gray (10YR 5/1) clay and many medium distinct yellowish brown (10YR 5/6) mottles, dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) and many medium distinct dark yellowish brown (10YR 3/4) mottles moist; massive; very hard, firm, sticky and plastic; very few very fine roots; common very fine and fine tubular and interstitual pores; continuous thin clay films lining pores and as bridges; moderately alkaline (pH 8.0).

The A horizon is mainly light brownish gray, gray, and grayish brown (10YR 6/1, 6/2, 5/1, and 5/2) silty clay loam or silty clay. In some pedons the upper part of the A horizon is overwash. Mottles range from few to many and from fine to medium.

The C horizon is dark grayish brown, gray, dark gray, very dark gray, or black (10YR 4/2, 5/1, 4/1, 3/1, and 2/1) silty clay loam, silty clay, or clay. Reaction is neutral to moderately alkaline. The content of salt crystals varies because of fluctuating ground water.

The Egbert soils in Napa County are less acid than is defined in the range for the series. This difference, however, does not greatly alter the use and behavior of the soils.

130—Egbert silty clay loam. This nearly level soil is on alluvial plains and basin rims. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Clear Lake, Haire, and Reyes soils and areas of soils that have slopes of 2 to 5 percent on basin rims.

Runoff is slow. The hazard of erosion is slight. Occasional flooding and a fluctuating water table are limitations to the use of this soil.

This soil is mainly used for hay. Some of the acreage is used for orchards and vineyards. Capability unit IVw–3 (14).

Fagan series

The Fagan series consists of well-drained soils on uplands. Slope is 5 to 50 percent. Elevation is 200 to 1,500 feet. These soils formed in material weathered from sandstone and shale. The plant cover is mostly annual grasses and forbs and sparse perennial grasses in some areas. Some areas on north-facing slopes are in oaks. The mean annual precipitation is 20 to 30 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is dark grayish brown, medium acid clay loam 10 inches thick. The subsoil is 36 inches thick. The upper 18 inches is dark grayish brown, and light olive brown, medium acid clay. The lower 18 inches is light yellowish brown, medium acid sandy clay loam. Weathered sandstone is at a depth of 46 inches.

Permeability is slow. The effective rooting depth is 40 to 60 inches. Available water capacity is 6 to 10 inches.

Fagan soils are used for range and pasture.

Representative profile of Fagan clay loam, 5 to 15 percent slopes, about ¾ mile north of intersection of State Highway 12 and Lynch Road, NE¼NW¼ sec. 5, T. 4 N., R. 3 W.:

Ap—0 to 6 inches, dark grayish brown (2.5Y 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; hard, friable, nonsticky and slightly plastic; many very fine roots; many interstitial pores; medium acid (pH 5.8); abrupt smooth boundary.

A12—6 to 10 inches, dark grayish brown (2.5Y 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong medium subangular blocky structure; hard, friable, sticky and slightly plastic; many, very fine and fine roots; many interstitial and tubular pores; medium acid (pH5.8); clear smooth boundary.

B1t—10 to 16 inches, dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure that parts to moderate medium subangular blocky; slightly hard and hard, friable, slightly sticky and plastic; common very fine roots; common tubular and interstitial pores; few thin clay films on peds; medium acid (pH 5.8); clear smooth boundary.

B21t—16 to 25 inches dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; weak medium angular blocky structure; very hard, firm, sticky and very plastic; few fine pores; thin continuous clay films on peds, medium acid (pH 5.8); gradual irregular boundary.

B22t—25 to 28 inches, light olive brown (2.5 5/6) clay, olive brown (2.5Y 4/4) moist; weak medium and coarse subangular blocky structure; very hard, firm, sticky and very plastic; thin continuous clay films on peds; medium acid (pH 5.8); clear irregular boundary.

B3t—28 to 46 inches, light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/5) moist; common fine distinct brown and common fine prominent black variegations; weak fine angular blocky structure; hard, friable, nonsticky and slightly plastic; few thin clay films on peds, medium acid (pH 5.8); gradual wavy boundary.

Cr—46 to 50 inches, light yellowish brown (10YR 6/4) soft sandstone; medium acid.

The A horizon is generally dark grayish brown or grayish brown (10YR 5/2, 4/2 and 2.5Y 5/2, 4/2) clay loam, but it is loam or clay loam in some profiles. Reaction is medium acid or slightly acid.

The Bt horizon is dark grayish brown, grayish brown, light yellowish brown, and light olive brown (10YR 5/2, 4/2, and 6/4 and 2.5Y 5/2, 4/2, 6/4, 5/4, and 5/6) clay loam, silty clay loam, sandy clay, and

silty clay. Depth to weathered sandstone ranges from 40 to 60 inches.

131—Fagan clay loam, 5 to 15 percent slopes. This moderately sloping to strongly sloping soil is on foot slopes on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bressa, Diablo, Dibble, and Haire soils and areas of soils in the vicinity of Kelly Road and Highway 12 that are dark fine sandy loam underlain by soft sandstone.

Runoff is medium. The hazard of erosion is moderate.

This soil is mainly used for range and pasture. A few small areas are in dryland grain. Capability unit IIIe–3 (15); Fine Loamy range site.

132—Fagan clay loam, 15 to 30 percent slopes. This moderately steep soil is on side slopes on uplands.

Included with this soil in mapping were small areas of Diablo, Dibble, Haire, and Hambright soils and a strong brown clayey soil that has a profile similar to this Fagan soil but is less than 40 inches deep to bedrock. Also included were small areas of a soil that is similar to this Fagan soil but that is calcareous in the subsoil.

Runoff is rapid. The hazard of erosion is moderate.

This soil is mainly used for range and pasture. A few small areas are in dryland grain. Capability unit IVe–3 (15); Fine Loamy range site.

133—Fagan clay loam, 30 to 50 percent slopes. This steep soil is on uplands.

Included with this soil in mapping were small areas of Diablo, Dibble, and Hambright soils. Also included were small areas of a fine sandy loam and areas of soils that are similar to this Fagan soil but that are less than 40 inches deep to bedrock.

Runoff is rapid. The hazard of erosion is high. This soil is subject to landslips.

This soil is used as range and watershed. Capability unit VIe–1 (15); Fine Loamy range site.

134—Fagan clay loam, 30 to 50 percent slopes, slipped. This steep soil is on uplands. It has a profile similar to the one described as representative for the series, but the areas are scarred with old and recent landslips. Occasional rock outcrops occur on ridgetops.

Included with this soil in mapping were small areas of Diablo, Dibble, and Hambright soils, small areas of soils less than 40 inches deep to bedrock, and small areas of soils that are alkaline or slightly calcareous in the subsoil. Occasional rock outcrops occur on ridgetops.

Runoff is rapid. The hazard of erosion is high.

This soil is used for range and watershed. Capability unit VIIe–1 (15); Fine Loamy range site.

Felta series

The Felta series consists of well drained soils on terraces. Slope is 5 to 50 percent. Elevation is 300 to 2,000 feet. These soils formed in material weathered from volcanic tuffs mixed with uplifted river sediment and metamorphosed basic rock. The vegetation is madrone, Douglas-fir, scrub oak, and manzanita. The mean annual precipitation is 30 to 40 inches, and the mean annual temperature is 50° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is grayish brown, slightly acid very gravelly loam 7 inches thick. The subsoil is grayish brown, medium acid very gravelly clay loam 19 inches thick. The substratum is brown, strongly acid very gravelly sandy clay loam.

Permeability is moderate. The effective rooting depth is 60 inches or more. Available water capacity is 4 to 6 inches.

Felta soils are used mostly for watershed, wildlife habitat, and recreation.

Representative profile of Felta very gravelly loam, in an area of Boomer-Forward-Felta complex, 5 to 30 percent slopes, about 1,800 feet west on Lyman Canyon Drive from State Highway 29 and 100 feet north of Lyman Canyon Road, NW¼NE¼ sec. 22, R. 6 W., T. 8 N.:

A1—0 to 7 inches, grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine interstitial pores; 50 percent gravel; slightly acid (pH 6.5); clear wavy boundary.

B21t—7 to 16 inches, grayish brown (10YR 5/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine interstitial pores; 60 percent gravel; medium acid (pH 6.0); clear wavy boundary.

B22t—16 to 26 inches, grayish brown (10YR 5/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine interstitial pores; common thin clay films lining pores and as brdges; 60 percent gravel; medium acid (pH 5.8); clear irregular boundary.

C—26 to 60 inches, brown (10YR 5/3) very sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm, slightly sticky and slightly plastic; few fine roots; common fine interstitial pores; common thin clay films lining pores and as bridges; 55 percent gravel; strongly acid (pH 5.5).

The A horizon is gray or grayish brown (10YR 5/1, 5/2). Reaction is slightly acid or neutral. The gravel content ranges from 50 to 60 percent.

The Bt horizon is gray or grayish brown (10YR 5/1, 5/2). Reaction is slightly acid or medium acid. The horizon is 50 to 60 percent gravel.

The C horizon is brown, pale brown, or brownish gray (10YR 6/3, 6/2, and 5/3). Reaction is medium acid to strongly acid. The gravel content ranges from 50 to 60 percent. Depth to weathered old alluvium is 40 to 60 inches or more.

Felta soils are mapped only in complexes with Boomer and Forward soils.

Felton series

The Felton series consists of well drained soils on uplands. Slope is 15 to 75 percent. Elevation is 300 to 2,000 feet. These soils formed in material weathered from sandstone and shale. The plant cover is Douglas-fir, ponderosa pine, manzanita, and fern and grasses and redwoods in moist draws. The mean annual precipitation is 25 to 35 inches, and the mean annual temperature is 54° to 56° F. Summers are warm and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is dark grayish brown, neutral gravelly loam 6 inches thick. The subsoil is about 27 inches thick. It is dark brown and brown, slightly acid clay loam in the upper 17 inches and reddish yellow, medium acid clay loam in the lower 10 inches. Weathered shale is at a depth of 33 inches.

Permeability is moderately slow. The effective rooting depth is 30 to 40 inches. Available water capacity is 5 to 8 inches.

These soils are used for timber and wildlife habitat.

Representative profile of Felton gravelly loam, 30 to 50 percent slopes, 1.87 miles north on Dry Creek Road from intersection with Orchard Avenue, 50 feet west of Dry Creek Road, T. 6 N., R. 5 W. (nonsectionalized):

O1—2 inches to 0, duff and litter.

A1—0 to 6 inches, dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine and common medium roots; common fine tubular pores; few thin clay films on peds and lining pores; 20 percent gravel; neutral (pH 7.0); clear, wavy boundary.

B1t—6 to 10 inches, dark grayish brown (10YR 4/2) gravelly clay loam, very dark brown (10YR 2/2) moist; weak fine subangular structure; soft, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine tubular and interstitial pores; common moderately thick clay films on peds and lining pores; 20 percent gravel; neutral (pH 7.0); clear wavy boundary.

B21t—10 to 14 inches, dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine tubular and interstitial pores; common moderately thick clay films on peds and lining pores; slightly acid (pH 6.5); clear wavy boundary.

B22t—14 to 23 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/2) moist; moderate medium and fine subangular blocky structure; hard, friable, sticky and plastic; common fine and few very fine roots; common very fine and fine tubular and interstitial pores; common moderately thick clay films on peds and lining pores; slightly acid (pH 6.2); gradual wavy boundary.

B23t—23 to 33 inches, reddish yellow (7.5YR 6/6) clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine tubular and interstitial pores; common, moderately thick clay films on peds and lining pores; medium acid (pH 6.0); gradual irregular boundary.

Cr—33 to 36 inches, weathered shale.

The A horizon is dark grayish brown, grayish brown, brown, or dark brown (10YR 5/2, 4/2, 5/3, and 4/3 and 7.5YR 5/2, 4/2) gravelly loam, loam, or clay loam. Structure is moderate granular to weak subangular blocky. Reaction is neutral or slightly acid.

The B2t horizon is brown, dark brown, strong brown, or reddish yellow (7.5 YR 5/2, 4/2, 5/4, 5/6, and 6/6) clay loam and may include subhorizons of clay. Depth to the Cr horizon is 30 to 40 inches.

The Felton soils in Napa County are shallower to bedrock than is defined in the range for the series. This difference, however, does not greatly alter the use and behavior of the soils.

135—Felton gravelly loam, 15 to 30 percent slopes. This moderately steep soil is on side slopes.

Included with this soil in mapping were small areas of Forward, Kidd, Lodo, and Sobrante soils. Also included were areas of soils that are similar to this Felton soil, but one is more than 40 inches deep to bedrock, one is strongly acid in the subsoil, and one has a clay subsoil.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used mostly for timber and wildlife habitat. Capability unit IVe–1 (5).

136—Felton gravelly loam, 30 to 50 percent slopes. This steep soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Forward, Kidd, Lodo, and Sobrante soils. Also included were small areas of soils that are similar to this Felton soil, but one is more than 40 inches deep to bedrock and one is strongly acid in the subsoil.

Runoff is rapid. The hazard of erosion is moderate to high.

This soil is used for timber and wildlife habitat. Capability unit VIe–1 (5).

137—Felton gravelly loam, 50 to 75 percent slopes. This very steep soil is on uplands.

Included with this soil in mapping were small areas of Dibble, Lodo, Los Gatos, and Maymen soils. Also included were small areas of soils that are similar to this Felton soil but that are more than 40 inches deep to bedrock.

Runoff is very rapid. The hazard of erosion is high.

This soil is mainly used for watershed and wildlife habitat. A few areas are used for timber. Capability unit VIIe–1 (5).

Forward series

The Forward series consists of well drained soils on uplands. Slope is 2 to 75 percent. Elevation is 400 to 3,500 feet. These soils formed in material weathered from rhyolite. The plant cover is Douglas-fir, madrone, scrub oak, pepper, and bay trees. The mean annual precipitation is 30 to 50 inches, and the mean annual temperature is 54° to 56° F. Summers are warm and dry, and winters are cool and moist. The frost-free season is 200 to 230 days.

In a representative profile the surface layer is light gray, slightly acid gravelly loam 4 inches thick. The subsoil is light gray, medium acid and strongly acid loam 22 inches thick. The substratum is light gray, strongly acid gravelly loam that overlies weathered rhyolitic tuff at a depth of 35 inches.

Permeability is moderately rapid. The effective rooting depth is 20 to 40 inches. Available water capacity is 2 to 4.5 inches.

Forward soils are used for watershed, wildlife habitat, and limited timber production.

Representative profile of Forward gravelly loam, 30 to 75 percent slopes, 30 feet north of southeast corner of parking lot facing southernmost building on Pacific Union College campus and 30 feet east, SW¼SW¼ sec. 8, T. 8 N., R. 5 W.:

O1—2 inches to 0, duff and litter; slightly acid.

A1—0 to 4 inches, light gray (10YR 6/1) gravelly loam, very dark grayish brown (10YR 3/2) moist; strong fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine, medium, and coarse roots; many very fine and fine interstitial pores; 20 percent gravel; slightly acid (pH 6.5); diffuse wavy boundary.

B1—4 to 10 inches, light gray (10YR 7/2) loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure that parts to weak fine granular; soft, friable, slightly sticky and slightly plastic; many very fine, fine, medium, and coarse roots; few medium and common very fine and fine tubular pores; 10 percent gravel; medium acid (pH 6.0); diffuse wavy boundary.

B21—10 to 17 inches, light gray (10YR 7/2) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure that parts to weak fine granular; soft, friable, slightly sticky and slightly plastic; few very fine, fine, medium, and coarse roots; few medium and common very fine and fine tubular pores; 10 percent gravel; medium acid (pH 5.8); gradual wavy boundary.

B22—17 to 26 inches, light gray (10YR 7/2) loam, brown (10YR 5/3) moist; weak medium subangular and weak fine granular structure; soft friable, slightly sticky and slightly plastic; few very fine and fine, common medium, and many coarse roots; few medium and common very fine and fine tubular pores; 10 percent gravel; strongly acid (pH 5.5); gradual wavy boundary.

C1—26 to 35 inches, light gray (10YR 7/2) gravelly loam, brown (10YR 5/3) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine and common medium roots; many very fine and fine tubular pores; 25 percent gravel; strongly acid (pH 5.5); gradual wavy boundary.

C2r—35 to 49 inches, light gray (10YR 7/1) weathered rhyolitic tuff, very pale brown (10YR 7/3) moist.

The A horizon is light gray, light brownish gray, or pale brown (10YR 6/1, 6/2, and 6/3) gravelly loam or loam. It is 10 to 20 percent gravel. Reaction is slightly acid or medium acid.

The B horizon is light gray or light brownish gray (10YR 7/2, 6/2) gravelly loam or loam. It is 10 to 20 percent gravel. Reaction is medium acid or strongly acid.

The C horizon is very pale brown or light gray (10YR 7/1, 7/2, 7/3, and 8/3) gravelly loam or loam. It is 10 to 30 percent gravel. Reaction is medium acid or strongly acid. Depth to weathered rhyolitic tuff is 20 to 40 inches.

138—Forward gravelly loam, 2 to 9 percent slopes. This gently sloping to moderately sloping soil is on side slopes on uplands.

Included with this soil in mapping were small areas of Aiken, Boomer, Kidd, and Sobrante soils. Also included were areas of soils that are similar to this Forward soil but that have a clay loam subsoil and that are less than 20 inches deep to bedrock.

Runoff is medium. The hazard of erosion is slight.

This soil is used for limited timber production, vineyards and orchards, wildlife habitat, and watershed. Capability unit IIIe–1 (5).

139—Forward gravelly loam, 9 to 30 percent slopes. This strongly sloping to moderately steep soil is on side slopes on uplands.

Included with this soil in mapping were small areas of Aiken, Boomer, Kidd, and Sobrante soils. Also included were areas of soils that are similar to this Forward soil but that have a clay loam subsoil and that are less than 20 inches deep to bedrock.

Runoff is medium. The hazard of erosion is slight to moderate.

This soil is used for limited timber production, wildlife habitat, and watershed. Capability unit IVe–1 (5).

140—Forward gravelly loam, 30 to 75 percent slopes. This steep and very steep soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping were small areas of Aiken, Boomer, Kidd, and Sobrante soils. Also included were areas of soils that are similar to this Forward soil but that have a clay loam subsoil and areas of clayey, less sloping soils.

Runoff is very rapid. The hazard of erosion is high to very high.

This soil is used for timber, recreation, wildlife habitat, and watershed. Capability unit VIIe–1 (5).

141—Forward-Kidd complex, 50 to 75 percent slopes. This complex consists of very steep soils on uplands. These soils are so intermingled that it was not practical to separate them at the scale used in mapping. Com-

monly, the Forward soils are on toe slopes and the Kidd soils on side slopes.

This complex is about 60 percent Forward soils, about 20 percent Kidd soils, and about 20 percent Aiken, Boomer, and Sobrante soils and areas of rock outcrop.

Runoff is rapid and the hazard of erosion is high in the less sloping areas. Runoff is very rapid and the hazard of erosion is very high in the more sloping areas.

The soils in this complex are used for limited timber production, wildlife habitat, and watershed. Capability unit VIIe–1 (5).

Guenoc series

The Guenoc series consists of well drained soils on uplands. Slope is 5 to 75 percent. Elevation is 700 to 3,000 feet. These soils formed in material weathered from basic igneous rock. The vegetation is mostly annual grasses, scattered oaks, and some brush in shallower areas. The mean annual precipitation is 25 to 35 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters cool and moist. The frost-free season is 200 to 230 days.

In a representative profile the surface layer is dark reddish brown and reddish brown, neutral loam 12 inches thick. The subsoil is dark red, neutral clay loam 18 inches thick. Fractured, shattered basalt is at a depth of 30 inches.

Permeability is moderately slow. The effective rooting depth is 25 to 40 inches. Available water capacity is 4.5 to 7 inches.

Guenoc soils are used mostly for range. Some areas are used for wildlife habitat and watershed.

Representative profile of Guenoc loam, 30 to 50 percent slopes, about 2,700 feet east on Spanish Valley Trail from intersection with Snell Valley Road and 100 feet southeast of Spanish Valley Trail, NW¼SE¼ sec. 22, T. 10 N., R. 5 W.:

A11—0 to 3 inches, dark reddish brown (5YR 3/2) loam, dark reddish brown (5YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine and fine tubular and interstitial pores; neutral (pH 7.0); clear wavy boundary.

A12—3 to 12 inches, reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; moderate medium and coarse angular and subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine and few medium roots; common very fine and fine tubular and interstitial pores; neutral (pH 7.0); clear irregular boundary.

B21t—12 to 22 inches, dark red (2.5YR 3/6) clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium and coarse angular and subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine, few coarse roots; common very fine and fine tubular and interstitial pores; few thin clay films on peds and lining pores; 10 percent gravel; neutral (pH 7.0); clear wavy boundary.

B22t—22 to 30 inches, dark red (2.5YR 3/6) clay loam, dark red (2.5YR 3/6) moist; massive; hard firm, sticky, plastic; common very fine and few coarse roots; common very fine and fine tubular and interstitial pores; few thin clay films lining pores; 10 percent gravel; neutral (pH 7.0); clear irregular boundary.

R—30 inches, fractured shattered basalt.

The A horizon is mainly dark brown, reddish brown, or dark reddish brown (7.5YR 4/2, 3/2 and 5YR 3/2, 5/3, 4/3, and 4/4) loam, but it is silty clay loam in some pedons. Reaction is slightly acid or neutral.

The Bt horizon is weak red, dusky red, and dark red (2.5YR 3/6, 3/2, and 4/2 and 10R 3/6, 3/2, and 4/2) clay loam or silty clay loam. It is 5 to 30 percent gravel, cobbles, and stones in some pedons where the Bt horizon is clay loam. Depth to shattered basalt is 25 to 40 inches.

142—Guenoc loam, 30 to 50 percent slopes. This steep soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Aiken, Felta, Hambright, Henneke, and Montara soils. Also included were areas of Rock outcrop and areas of soils that have stones on the surface.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIe–1 (15); Loamy Upland range site.

143—Guenoc-Rock outcrop complex, 5 to 30 percent slopes. This complex consists of areas of Rock outcrop and soils on uplands mainly in the Snell Valley area adjoining Lake County. The soils formed in material weathered from basalt and andesite. The areas are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 60 percent Guenoc soils, 30 percent Rock outcrop, and 10 percent Felta, Hambright, Henneke, Maxwell, and Montara soils. Rock outcrop is in areas 1 to 5 acres in size. It consists of andesite and basalt boulders, stones, or outcrops. Some areas of this complex that are not in Snell Valley are less rocky and have a surface layer of silt loam.

Runoff is rapid. The hazard of erosion is moderate.

This complex is mainly used for wildlife habitat, watershed, and limited grazing. Some areas near Lake Berryessa are used for recreation. Capability unit VIe-1 (15); Loamy Upland range site.

144—Guenoc-Rock outcrop complex, 30 to 75 percent slopes. This complex consists of areas of Rock outcrop and steep to very steep soils on uplands mainly in the Snell Valley area adjoining Lake County. The soils formed in material weathered from andesite and basalt. The areas are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 50 percent Guenoc soils, 40 percent Rock outcrop, and 10 percent Felta, Hambright, Henneke, and Montara soils. Rock outcrop is in areas 1 to 5 acres in size. It consists of andesite and basalt boulders, stones, or outcrops.

Runoff is rapid in the less sloping areas and very rapid in the steeper areas. The hazard of erosion is high.

This complex is mainly used for wildlife habitat, watershed, and limited grazing. Some areas near Lake Berryessa are used for recreation. Capability unit VIIe-1 (15); Loamy Upland range site.

Haire series

The Haire series consists of moderately well drained soils on old terraces and alluvial fans. Slope is 0 to 30 percent. Elevation is 20 to 300 feet. These soils formed from alluvium derived from sedimentary rock. The vegetation in uncultivated areas consists of annual grasses and forbs. The mean annual precipitation is 25 to 30 inches, and the mean annual air temperature is 58° to 60° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is brown and grayish brown medium acid loam 22 inches thick. The subsurface layer is light gray medium acid sandy clay loam 5 inches thick. The subsoil is pale brown very strongly acid clay to a depth of 45 inches. Below this, it is pale yellow very strongly acid sandy clay to a depth of 60 inches.

Permeability is very slow. The effective rooting depth is mainly 60 inches or more, but it is 20 to 30 inches for most locally grown root-sensitive crops. The available water capacity is 3 to 6 inches.

Haire soils are mainly used for dryland and irrigated pasture. Some areas are used for small prune orchards, but many of these are being planted to varietal grapes. Some other areas are used for range.

Representative profile of Haire loam, 0 to 2 percent slopes, about 600 feet south and 300 feet east of first right turn on Green Island Road about 1⅛ miles west of State Highway 29, SE¼NW¼ sec. 14, T. 4 N., R. 4 W.:

Ap1—0 to 6 inches, brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine interstitial and tubular pores; medium acid (pH 5.6); abrupt wavy boundary.

Ap2—6 to 15 inches, brown (10YR 5/3) loam and common fine distinct dark brown (7.5YR 3/2) mottles, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common fine and few coarse interstitial and tubular pores; medium acid (pH 6.0); clear smooth boundary.

A13—15 to 22 inches, grayish brown (10YR 5/2) loam and common, fine, faint dark yellowish brown (10YR 4/4) mottles, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine interstitial pores, more porous than Ap2; medium acid (pH 6.0); clear smooth boundary.

A2—22 to 27 inches, light gray (10YR 7/2) sandy clay loam, mixed light brownish gray (10YR 6/2) and yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, slightly sticky and plastic; common very fine roots; common fine interstitial pores; medium acid (pH 6.0); abrupt wavy boundary.

B2t—27 to 45 inches, pale brown (10YR 6/3) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, extremely firm, very sticky and very plastic; common interstitial pores; many thick clay films lining pores and as bridges; very strongly acid (pH 5.0); clear smooth boundary.

B3t—45 to 60 inches, pale yellow (5Y 7/3) sandy clay, yellowish brown (10YR 5/4) and pale brown (10YR 6/3) moist; massive; slightly hard, friable, very sticky and very plastic; few thick clay films with clay mainly as bridges; very strongly acid (pH 5.0).

The A horizon is grayish brown or brown (10YR 5/2, 5/3) loam or clay loam. Reaction is medium acid or strongly acid.

The B2t horizon ranges from very pale brown to light yellowish brown (10YR 7/3, 7/4, 6/2, and 6/4). Reaction is medium acid to very strongly acid. The B2t horizon is underlain by strongly acid or very strongly acid layers of very gravelly, very cobbly, or stony clay loam or sandy clay, some of which are semicemented.

145—Haire loam, 0 to 2 percent slopes. This nearly level soil is on old low terraces and alluvial fans. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Clear Lake, Cole, Pleasanton, and Reyes soils. Also included were areas of soils where subsoiling has caused mixing of the surface layer with material from the subsoil and areas of soils that have a surface layer of sandy loam.

Runoff is slow. There is little or no hazard of erosion.

The soil is used for pasture, but much of the acreage is being planted to vineyards. Capability unit IIIs-3 (14); Claypan range site.

146—Haire loam, 2 to 9 percent slopes. This gently sloping to moderately sloping soil is on old terraces and alluvial fans.

Included with this soil in mapping were small areas of Clear Lake, Fagan, Diablo, and Dibble soils. Also included were areas of soils that have a surface layer of sandy loam and areas of soils that the similar to this Haire soil but that are redder throughout the profile.

Runoff is slow to medium. The hazard of erosion is slight.

This soil is mainly used for grazing, but some of these areas are being planted to varietal wine grapes. Capability unit IIIe-3 (14); Claypan range site.

147—Haire clay loam, 0 to 2 percent slopes. This nearly level soil is on old low terraces and alluvial fans.

Included with this soil in mapping were small areas of Cole and Reyes soils. Also included were areas of soils where subsoiling has caused mixing of the surface layer with material from the subsoil.

Runoff is slow. There is no hazard of erosion.

This soil is mainly used for pasture, but some of these areas are being planted to varietal wine grapes. Capability unit IIIs-3 (14); Claypan range site.

148—Haire clay loam, 2 to 9 percent slopes. This gently sloping to moderately sloping soil is on old terraces and alluvial fans.

Included with this soil in mapping were small areas of Clear Lake, Diablo, Dibble, and Fagan soils. Also included were areas of soils that are similar to this Haire soil but that are redder throughout the profile.

Runoff is slow to medium. The hazard of erosion is slight.

This soil is mainly used for grazing, but some of these areas are being planted to wine grapes. Capability unit IIIe-3 (14); Claypan range site.

149—Haire clay loam, 9 to 15 percent slopes. This strongly sloping soil is on old terraces.

Included with this soil in mapping were small areas of Diablo, Dibble, Fagan, and Millsholm soils. Also included were areas of soils that are similar to this Haire soil but that are redder throughout the profile.

Runoff is medium. The hazard of erosion is moderate.

This soil is mainly used for range. Some small areas are used for dryfarmed grain. Capability unit IVe-3 (15); Claypan range site.

150—Haire clay loam, 15 to 30 percent slopes. This hilly soil is on terraces.

Included with this soil in mapping were small areas of Diablo, Dibble, Fagan, and Millsholm soils. Also included were areas of Haire soils that are subject to a moderate hazard of sheet erosion and areas of soils that are similar to this Haire soil but that are redder throughout the profile.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used mostly for range and some limited dryfarmed grain. Capability unit VIe-1 (15); Claypan range site.

Hambright series

The Hambright series consists of well drained soils on uplands. Slope is 2 to 75 percent. Elevation is 400 to 2,500 feet. These soils formed in material weathered from basic volcanic rock. The vegetation is annual grasses and forbs and oaks on gentler slopes. Most of the areas are brushy and rocky. The mean annual precipitation is 23 to 35 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is dark grayish brown and brown, medium acid very stony loam and about 6 inches thick. The subsoil is dark brown, medium acid very stony loam about 6 inches thick. Fractured basic igneous bedrock is at a depth of 12 inches.

Permeability is moderate. The effective rooting depth is 10 to 20 inches. Available water capacity is 1 to 2 inches.

Hambright soils are mainly used for wildlife habitat and watershed, and a few areas are used for range.

Representative profile of Hambright very stony loam, in an area of Hambright-Rock outcrop complex, 30 to 75 percent slopes, 1 mile southwest of Milliken Reservoir and about 100 feet west of Atlas Peak Road, NE¼NE¼ sec. 13, R. 4 W., T. 6 N.:

A1—0 to 1 inch, dark grayish brown (10YR 4/2) very stony loam, dark brown (7.5YR 3/2) moist; weak fine and medium granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine tubular and interstitial pores; 50 percent pebbles, cobbles, and stones; medium acid (pH 5.6); clear smooth boundary.

A3—1 inch to 6 inches, brown (10YR 4/3) very stony loam, dark reddish brown (5YR 3/2) moist; massive; slightly hard, friable, nonsticky and slightly plastic; common very fine roots; many very fine tubular pores; 60 percent pebbles, cobbles, and stones; medium acid (pH 5.6); clear wavy boundary.

B2—6 to 12 inches, dark brown (7.5YR 4/4) very stony loam, dark reddish brown (5YR 3/2) moist; massive; slightly hard, friable, nonsticky and slightly plastic; common very fine roots; many very fine tubular pores; 60 percent pebbles, cobbles, and stones; medium acid (pH 5.6); abrupt wavy boundary.

R—12 inches, fractured basic igneous bedrock.

The A horizon is dark grayish brown, brown, dark brown, or reddish brown (10YR 4/2, 4/3; 7.5YR 4/2, 4/4; 5YR 5/3, 4/3) loam and is gravelly, stony, or cobbly. Coarse fragments make up 35 to more than 75 percent of this horizon. Reaction is slightly acid or medium acid.

The B2 horizon is dark brown, dark reddish brown, or reddish brown (7.5YR 4/3, 4/4, and 5YR 3/2, 3/3, 3/4, 5/3, and 4/3) loam and is gravelly, stony, or cobbly. Coarse fragments make up 35 to more than 75 percent of this horizon. Depth to fractured basic igneous bedrock ranges from 10 to 20 inches.

151—Hambright-Rock outcrop complex, 2 to 30 percent slopes. This complex consists of areas of Rock outcrop and soils on plateaus and uplands mainly in the Atlas Peak and Soda Canyon areas. The soils formed in material weathered from basic rock. The areas are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 50 percent Hambright soils, 25 to 30 percent Rock outcrop, and 15 to 25 percent Forward, Guenoc, Kidd, and Sobrante soils. Rock outcrop is in areas 1 to 5 acres in size. It consists of basic igneous boulders, cobbles, rhyolitic material, stones, or outcrops.

Runoff is medium to rapid. The hazard of erosion is slight to moderate.

This complex is used for wildlife habitat, watershed, and limited grazing. Capability unit VIe-1 (15); Very Shallow Rocky range site.

152—Hambright-Rock outcrop complex, 30 to 75 percent slopes. This complex consists of areas of Rock outcrop and steep and very steep soils on uplands mainly in the Atlas Peak area. The soils formed in material weathered from basic rock. The areas are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 50 percent Hambright soils, 30 to 40 percent Rock outcrop, and 10 to 20 percent Forward, Guenoc, Henneke, Kidd, and Sobrante soils. The Hambright soils have the profile described as representative of the series. Rock outcrop is in areas

1 to 5 acres in size. It consists of cobbles, stones, rhyolitic masses, or outcrops.

Runoff is rapid to very rapid. The hazard of erosion is high.

This complex is used for wildlife habitat, recreation, watershed, and limited grazing. Capability unit VIIe-1 (15); Very Shallow Rocky range site.

Henneke series

The Henneke series consists of excessively drained soils on uplands. Slope is 5 to 75 percent. Elevation is 500 to 4,000 feet. These soils formed in material weathered from serpentine. The vegetation is scattered oak, digger pine, scrub oak, manzanita, muskbrush, toyon, MacNabb cypress, and a few annual grasses. The mean annual precipitation is 25 to 45 inches, and the mean annual temperature 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is reddish brown, neutral gravelly loam 7 inches thick. The subsoil is reddish brown, mildly alkaline very gravelly clay loam 8 inches thick. Fractured, greenish blue serpentine is at a depth of 15 inches.

Permeability is moderately slow. The effective rooting depth is 10 to 20 inches. Available water capacity is 1 to 3 inches.

Henneke soils are used for wildlife habitat, watershed, and limited grazing.

Representative profile of Henneke gravelly loam, 30 to 75 percent slopes, 200 feet north and 200 feet west of intersection of Pope Canyon and Berryessa-Knoxville Roads, R. 4 W., T. 9 N. (nonsectionalized):

A1—0 to 7 inches, reddish brown (5YR 4/3) gravelly loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; soft, very friable, slightly sticky and nonplastic; common very fine and fine roots; many very fine and fine tubular pores; 30 percent gravel; neutral (pH 7.0); abrupt smooth boundary.

B2t—7 to 15 inches, reddish brown (5YR 3/4) very gravelly clay loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; slightly hard, firm, slightly sticky, slightly plastic; thin continuous clay films lining pores; 50 percent gravel; mildly alkaline (pH 7.5); abrupt wavy boundary.

R—15 inches, fractured greenish blue serpentine.

The A1 horizon is dark brown, reddish gray, or reddish brown (7.5YR 4/2 and 5YR 4/3, 5/2, and 5/3) gravelly loam or gravelly clay loam. The gravel content ranges from 25 to 35 percent. Reaction is slightly acid or neutral.

The B2t horizon ranges from dark brown, reddish yellow, reddish brown, dusky red, or red (5YR 7/6, 6/6, 4/3, 5/4, and 3/4 and 2.5YR 3/2, 5/6, and 4/6) clay loam or clay that has gravel, cobbles or stones. Rock fragments make up 35 to 50 percent of the horizon. Reaction is neutral to moderately alkaline. Depth to weathered serpentine ranges from 10 to 20 inches.

153—Henneke gravelly loam, 5 to 30 percent slopes. This gently sloping to moderately steep soil is on toe slopes on uplands.

Included with this soil in mapping were small areas of Bressa, Dibble, Lodo, Maymen, and Montara soils. Also included were small areas of dark gray clayey soils that crack upon drying, a few areas of rock outcrop that make up about 5 percent of this unit, and areas of soils that are similar to this Henneke soil but that are more than 20 inches deep to bedrock or are browner.

Runoff is medium to rapid. The hazard of erosion is slight to moderate. This soil is very low in fertility.

This soil is used mostly for wildlife habitat, recreation, and watershed. A few areas are used for range. Capability unit VIIe-1 (15); Rocky Serpentine range site.

154—Henneke gravelly loam, 30 to 75 percent slopes. This steep and very steep soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Lodo, Maymen, and Montara soils. Also included were small areas of rock outcrop that make up about 10 percent of this unit and areas of soils that are similar to this Henneke soil but that are more than 20 inches to bedrock or are browner.

Runoff is rapid to very rapid. The hazard of erosion is moderate to high. This soil is very low in fertility.

This soil is used for wildlife habitat, recreation, and watershed. A few areas are used for range. Capability unit VIIe–1 (15); Rocky Serpentine range site.

Kidd series

The Kidd series consists of well drained soils on uplands. Slope is 15 to 75 percent. Elevation is 500 to 4,300 feet. These soils formed in material weathered from rhyolite. The vegetation includes manzanita, chamise, ceanothus, scrub oak, grasses, and forbs and a few ponderosa pine. The mean annual precipitation is 30 to 60 inches, and the mean annual temperature is 50° to 58° F. Summers are warm and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is grayish brown, medium acid loam 4 inches thick. The subsoil is very pale brown, medium acid loam 10 inches thick. Fractured rhyolitic tuff bedrock is at a depth of 14 inches.

Permeability is moderately rapid. The effective rooting depth is 12 to 15 inches. Available water capacity is 1 to 3 inches.

Kidd soils are used for range where areas are accessible to livestock and for wildlife habitat and recreation.

Representative profile of Kidd loam, 30 to 75 percent slopes, 500 feet west of intersection of Deer Park and Crestmont Drive and 150 feet south of Deer Park Road, SW¼SW¼ sec. 7, T. 8 N., R. 5 W.:

A1—0 to 4 inches, grayish brown (10YR 5/2) and very pale brown (10YR 7/3) loam, dark brown (7.5 YR 3/2) and brown (7.5YR 4/4) moist; moderate medium crumb structure; slightly hard, friable, slightly sticky and

slightly plastic; many fine and medium roots; many very fine and fine interstitial and tubular pores; 10 percent gravel; medium acid (pH 5.8); clear smooth boundary.

B21—4 to 10 inches, very pale brown (10 YR 7/3) loam, brown (7.5YR 4/4, 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many very fine and fine and common medium interstitial and tubular pores; 10 percent gravel; medium acid (pH 6.0); clear wavy boundary.

B22—10 to 14 inches, very pale brown (10YR 8/3) loam, light yellowish brown (10YR 6/4) moist; massive; hard, friable, slightly sticky and slightly plastic; few fine roots; many fine tubular pores; 10 percent gravel; medium acid (pH 6.0); abrupt irregular boundary.

R—14 inches, white (10YR 8/1) shattered hydrolitic tuff.

The A horizon ranges from very pale brown to gray and grayish brown (10YR 8/3, 8/4, 7/3, 7/4, 6/3, 6/2, 6/1, and 5/2) gravelly loam or loam. Reaction is slightly acid or medium acid. Gravel content ranges from 10 to 20 percent.

The B2 horizon ranges from very pale brown to light gray and grayish brown (10YR 8/3, 7/3, 7/4, 6/2, 5/2, and 5/1) sandy loam, loam, or clay loam and is 5 to 10 inches thick. Gravel content ranges from 10 to 20 percent. Hard fractured rhyolitic rock is at a depth of 12 to 15 inches.

155—Kidd loam, 15 to 30 percent slopes. This moderately steep soil is on uplands.

Included with this soil in mapping were small areas of Aiken, Boomer, Forward, and Hambright soils. Also included were areas of soils that are similar to this Kidd soil, but they have a light brown to pink surface layer and a brown to strong brown subsoil, or they have a subsoil of clay loam.

Runoff is medium. The hazard of erosion is moderate if the plant cover is disturbed.

This soil is used for wildlife habitat, recreation, and watershed. Capability unit VIe–1 (15); Very Shallow Rocky range site.

156—Kidd loam, 30 to 75 percent slopes. This steep to very steep soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Aiken, Boomer, Forward, and Hambright soils. Also included were areas of soils that are similar to this Kidd soil but that have a light brown to pink surface layer and a brown to strong brown subsoil.

Runoff is rapid and very rapid. The hazard of erosion is high to very high.

This soil is used for wildlife habitat, recreation, and watershed. Capability unit VIIe–1 (15); Very Shallow Rocky range site.

Lodo series

The Lodo series consists of somewhat excessively drained soils on uplands. Slope is 30 to 75 percent. Elevation is 400 to 2,500 feet. These soils formed in material weathered from sandstone and shale. The vegetation is chamise, manzanita, and scrub oak and small trees in protected areas. The mean annual precipitation is 30 to 40 inches, and the mean annual temperature is 60° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is brown, neutral loam 4 inches thick. The subsoil is brown, neutral heavy loam 3 inches thick. Fractured sandstone is at a depth of 7 inches.

Permeability is moderate. The effective rooting depth is 6 to 20 inches, but in most areas it is 6 to 12 inches. The available water capacity is 1 to 3.5 inches.

Lodo soils are mainly used for wildlife habitat and watershed. A few areas are used for range.

Representative profile of Lodo loam, in an area of Lodo-Maymen-Felton association, 30 to 75 percent slopes, 600 feet east on Oakville Grade Road from intersection with Dry Creek Road and 300 feet north of Oakville Grade Road, NW¼SE¼, R. 5 W., T. 7 N.:

A1—0 to 4 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak, very fine and medium granular structure; soft, friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine and medium tubular and interstitial pores; neutral (pH 6.7); clear wavy boundary.

B2—4 to 7 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 3/2) moist; weak medium granular and weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine and medium tubular and interstitial pores; neutral (pH 6.7); clear wavy boundary.

R—7 inches, fractured fine grained sandstone.

The A1 horizon is mainly grayish brown or brown (10YR 4/3 and 5/2 and 2.5Y 5/2) loam or clay loam, but it is shaly loam or shaly clay loam in some profiles. Reaction is slightly acid or neutral.

The B2 horizon is mainly brown or yellowish brown (10YR 5/3, 5/4 and 7.5YR 5/4) loam or clay loam, but it is shaly loam or shaly clay loam in some profiles. Reaction is slightly acid or neutral. Depth to fractured, fine grained standstone and shale is 6 to 20 inches.

The soil is mapped only in association with Maymen, Millsholm, and Felton soils.

157—Lodo-Maymen-Felton association, 30 to 75 percent slopes. This association consists of steep and very steep soils on hills mainly in the Dry Creek-Oakville Grade area in the central part of Napa County. The Lodo soils in this association are in convex areas on south-facing slopes of 50 to 75 percent, and they are covered by brush and grass. The Maymen soils are on north-facing slopes of 30 to 50 percent, and they are covered by dense brush. The Felton soils are on north- and east-facing slopes that border Dry Creek and that are in moist draws; they are mainly covered by conifers, but some of the areas have a deciduous cover of chamise, forbs, and grasses.

This association is mainly 60 percent Lodo soils, 20 percent Maymen soils, and 20 percent Felton soils. In areas near Greeg Mountain and west of Pope Valley, the association is 45 percent Lodo soils, 25 percent Maymen soils, 20 percent Felton soils, and 10 percent Millsholm soils and soils that are similar to Lodo soils but that are more than 10 inches deep to bedrock.

Runoff is rapid to very rapid. The hazard of erosion is high to very high. It is higher in the Lodo soils than in the other soils of this association.

These soils are used for timber, range, watershed, and wildlife habitat. Capability unit VIIe–1 (15); Lodo and Maymen parts in Shallow Coarse Loamy range site, Felton part not assigned to a range site.

Los Gatos series

The Los Gatos series consists of well drained soils on uplands. Slope is 5 to 75 percent. Elevation is 400 to 2,500 feet. These soils formed in material weathered from sandstone. The vegetation is mainly brush and a few scattered oaks and small areas of grass. The mean annual precipitation ranges from 30 to 40 inches, and the mean annual temperature is 54° to 57° F. Summers are warm and dry, and winters are cool and moist. The frost-free season is 220 to 250 days.

In a representative profile the surface layer is yellowish brown and brown, neutral loam 16 inches thick. The subsoil is brown, slightly acid loam and clay loam 20 inches thick. Massive sandstone is at a depth of 36 inches.

Permeability is moderately slow. The effective rooting depth is 22 to 40 inches. Available water capacity is 3 to 8 inches.

Los Gatos soils are mainly used for wildlife habitat and watershed. A few areas are used for range.

Representative profile of Los Gatos loam, 30 to 50 percent slopes, 800 feet east of Markley Resort off State Highway 128, NW¼SW¼ sec. 31, T. 8 N., R. 2 W.:

A11—0 to 8 inches, yellowish brown (10YR 5/4) loam, dark brown (10YR 3/3) moist; moderate medium granular structure; hard, friable, slightly sticky and slightly plastic; common fine and medium and few coarse roots; common fine tubular and many very fine interstitial pores; neutral (pH 7.0); gradual smooth boundary.

A12—8 to 16 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and medium roots; common fine tubular and many very fine interstitial pores; neutral (pH 7.0); gradual smooth boundary.

B1t—16 to 25 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and plastic; common fine tubular and many very fine interstitial pores; common thin clay films lining pores; slightly acid (pH 6.5); gradual smooth boundary.

B2t—25 to 36 inches, brown (7.5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine tubular and many interstitial pores; common thin clay films lining pores; slightly acid (pH 6.5); clear smooth boundary.

R—36 inches, brown (7.5YR 5/4) massive sandstone, dark brown (7.5YR 4/2) moist.

The A horizon is yellowish brown, grayish brown, or brown (10YR 5/4, 5/3, and 5/2 and 7.5YR 5/2, 4/2) loam, gravelly loam, clay loam, or gravelly clay loam. The gravel content is 0 to 20 percent. Reaction is slightly acid or neutral.

The Bt horizon is mainly brown, reddish brown, or yellowish red (7.5YR 5/4 and 5YR 5/3, 4/3, 5/6, and 4/6) clay loam, but it is gravelly clay loam in some profiles. The gravel content is 0 to 20 percent. Reaction is medium acid to neutral. Depth to sandstone is 20 to 40 inches.

158—Los Gatos loam, 5 to 30 percent slopes. This moderately sloping to moderately steep soil is on toe slopes and side slopes on uplands.

Included with this soil in mapping were small areas of Bressa, Henneke, Lodo, Maymen, Montara, and Sobrante soils. Also included were small areas of a clay soil that formed in material weathered from basic rock and areas of gravelly soils along the western shore of Lake Berryessa.

Runoff is medium. The hazard of erosion is slight.

This soil is used for range and wildlife habitat and for recreation in the Lake Berryessa area. Capability unit IVe–1 (15); Loamy Upland range site.

159—Los Gatos loam, 30 to 50 percent slopes. This steep soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bressa, Henneke, and Sobrante soils. Also included were areas of gravelly Los Gatos soils along the western shore of Lake Berryessa.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used for range and wildlife habitat and for recreation in the Lake Berryessa area. Capability unit VIe–1 (15); Loamy Upland range site.

160—Los Gatos loam, 50 to 75 percent slopes. This very steep soil is on uplands.

Included with this soil in mapping were small areas of Bressa, Dibble, Lodo, Maymen, and Sobrante soils and areas of Los Gatos soils, along the western shore of Lake Berryessa, that have gravelly layers.

Runoff is rapid. The hazard of erosion is high.

This soil is used for watershed and wildlife habitat. Capability unit VIIe–1 (15); Loamy Upland range site.

Maxwell series

The Maxwell series consists of somewhat poorly drained soils on old alluvial fans and basin rims. Slope is 2 to 9 percent. Elevation is 200 to 1,500 feet. These soils formed in material derived from serpentinitic alluvium. The vegetation is a sparse growth of lupine, tarweed, wild oats, and other annuals. The mean annual precipitation is 30 to 35 inches, and the mean annual temperature is 60° to 62° F. Summers are hot

and dry, and winters are cool and moist. The frost-free season is 200 to 250 days.

In a representative profile the surface layer is dark gray, mildly alkaline and moderately alkaline clay 38 inches thick. The underlying material, to a depth of 62 inches or more, is gray, moderately alkaline clay that is calcareous at a depth of more than 48 inches.

Permeability is very slow. The effective rooting depth is 60 inches or more. Available water capacity is 10 to 12 inches. Most areas of this soil are artificially drained and have a water table at a depth of more than 5 feet.

Maxwell soils are used for range and for improved annual pasture if irrigation water is available.

Representative profile of Maxwell clay, 2 to 9 percent slopes, 250 feet east of Pope Canyon Road and 700 feet west and 250 feet south of center of sec. 14, T. 9 N., R. 5 W.:

A11—0 to 10 inches, dark gray (N 4/) clay, very dark gray (N 3/) moist; moderate medium prismatic structure; extremely hard, very firm, sticky and very plastic; common very fine roots; common very fine tubular pores; many slickensides; mildly alkaline (pH 7.5); gradual smooth boundary.

A12—10 to 26 inches, dark gray (N 4/) clay, very dark gray (N 3/) moist; strong medium prismatic structure; very hard, very firm, sticky and plastic; common very fine roots; common very fine tubular pores; many slickensides; moderately alkaline (pH 8.0); gradual smooth boundary.

AC—26 to 38 inches, dark gray (N 4/) clay, dark gray (N 4/) moist; moderate medium prismatic structure; very hard, very firm, sticky and very plastic; few very fine roots; few very fine tubular pores; few slickensides; moderately alkaline (pH 8.0); gradual smooth boundary.

C1—38 to 48 inches, gray (N 5/) clay, dark gray (5Y 4/1) moist; massive; very hard, very firm, sticky and very plastic; few very fine roots; few very fine tubular pores; moderately alkaline (pH 8.0); gradual smooth boundary.

C2—48 to 62 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; massive; very hard, very firm, sticky, very plastic; few very fine roots; few very fine tubular pores; moderately alkaline (pH 8.0); strongly effervescent; lime in medium sized soft masses.

The A horizon is mainly gray, dark gray, very dark gray, or black (N 5/, N 4/, N 3/, and N 2/) clay; but in some pedons it is clay loam; and in some areas at the edge of Pope Valley it is gravelly or cobbly.

In the more poorly drained areas, the lower part of the C horizon may be greenish-gray.

161—Maxwell clay, 2 to 9 percent slopes. This gently sloping to moderately sloping soil is on old alluvial fans and basin rims. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Montara and Tehama soils and small areas of soils that are similar to this Maxwell soil but that are reddish brown to dark reddish brown. Also included were areas of soils in the Whitehall Lane area that have slopes of 0 to 2 percent.

Runoff is slow. The hazard of erosion is slight. This soil is low in fertility.

This soil is used for range and improved annual pasture. Capability unit IVs–9 (15); Serpentine range site.

Maymen series

The Maymen series consists of somewhat excessively drained soils on uplands. Slope is 30 to 75 percent. Elevation is 400 to 2,500 feet. These soils formed in material weathered from sandstone and shale. The vegetation is chamise, manzanita, and scrub oak and small trees in protected areas. The mean annual precipitation is 30 to 40 inches, and the mean annual temperature is 54° to 56° F. Summers are warm and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is pale brown, medium acid gravelly loam 6 inches thick. The subsoil is light yellowish brown, strongly acid gravelly loam 6 inches thick. Fractured sandstone is at a depth of 12 inches.

Permeability is moderate. The effective rooting depth is 10 to 20 inches. The available water capacity is 1 to 2 inches.

Maymen soils are used for wildlife habitat, recreation, and watershed.

Representative profile of Maymen gravelly loam, in an area of Maymen-Los Gatos complex, 50 to 75 percent slopes, about ¼ mile northwest of Markley Canyon Resort, SE¼NW¼ sec. 31, T. 8 N., R. 2 W.:

A1—0 to 6 inches, pale brown (10YR 6/3) gravelly loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine and fine tubular pores; 20 percent gravel; medium acid (pH 5.8); gradual smooth boundary.

B2—6 to 12 inches, light yellowish brown (10YR 6/4) gravelly loam, dark yellowish brown (10 YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many fine and very fine tubular pores; 20 percent gravel; strongly acid (pH 5.5); clear wavy boundary.

R—12 inches, light yellowish brown (10YR 6/4) fractured sandstone.

The A1 horizon is mainly pale brown, light brownish gray, or light yellowish brown (10 YR 6/2, 6/3, and 6/4) gravelly loam, but in some pedons it is sandy loam or loam. It is 15 to 20 percent gravel. Reaction is slightly acid or medium acid.

The B2 horizon is mainly light yellowish brown, yellowish brown, or brownish yellow (10YR 5/4, 6/4, and 6/6) gravelly loam, but in some pedons it is sandy loam. It is 15 to 20 percent gravel. Reaction is medium acid or strongly acid. Rock outcrops are commonly

associated with this soil. Depth to sandstone or shale ranges from 10 to 16 inches.

162—Maymen-Los Gatos complex, 50 to 75 percent slopes. This complex consists of soils on uplands. These soils are so intermingled that it was not practical to separate them at the scale used in mapping.

This complex is about 60 percent Maymen soils, 25 percent Los Gatos soils, and 15 percent small areas of Lodo and Millsholm soils and areas of Rock outcrop.

Runoff is rapid on the Los Gatos soils and very rapid on the Maymen soils. The hazard of erosion is high in the Los Gatos soils and very high in the Maymen soils.

The soils in this complex are used for range, wildlife habitat, and watershed and for recreation in areas near Lake Berryessa. Capability unit VIIe–1 (15); Maymen part in Shallow Coarse Loamy range site, Los Gatos part in Loamy Upland range site.

163—Maymen-Millsholm-Lodo association, 30 to 75 percent slopes. This association consists of steep and very steep soils on hills mainly in the northern part of Napa County bordering Yolo County and extending southward to Lake Berryessa. The Maymen soils in this association are in convex areas on north-facing slopes of mainly 30 to 75 percent. The Millsholm soils are in convex areas on south-facing slopes of mainly 50 to 60 percent near ridge peaks. The Lodo soils are in convex areas on south-facing slopes of mainly 30 to 75 percent.

This complex is about 50 percent Maymen soils, 20 percent Millsholm soils, 20 percent Lodo soils, and 10 percent Rock outcrop.

Runoff is rapid on slopes of less than 50 percent and very rapid on slopes of more than 50 percent. The hazard of erosion is high or very high. It is higher in the Lodo soils than in the other soils of this association.

These soils are used for range, watershed, and wildlife habitat. Capability unit VIIe–1 (15); Shallow Coarse Loamy range site.

Millsholm series

The Millsholm series consists of well drained soils on uplands. Slope is 15 to 75 percent. Elevation is 500 to 2,500 feet. These soils formed in material weathered from sandstone and shale. The native vegetation is mainly annual grasses and a few oaks. In some areas the cover is brush. The mean annual precipitation is 25 to 35 inches, and the mean annual temperature is 60° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is pale brown, medium acid loam 4 inches thick. The subsoil is yellowish brown, medium acid clay loam. Sandstone is at a depth of 12 inches.

Permeability is moderate. The effective rooting depth is 10 to 20 inches. Available water capacity is 2 to 4 inches.

Millsholm soils are mainly used for range. Some areas in the southwestern part of the county are used for dairy pasture.

Representative profile of Millsholm loam, 15 to 30 percent slopes, 1,400 feet south on Browns Valley Road from intersection of Redwood Road and 1,500 feet east of Browns Valley Road, T. 5 N., R. 4 W. (nonsectionalized):

A1—0 to 4 inches, pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; medium acid (pH 6.0); gradual smooth boundary.

B2—4 to 12 inches, yellowish brown (10YR 5/4) clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and plastic; many fine roots; common fine tubular pores; medium acid (pH 6.0); clear smooth boundary.

R—12 inches, light yellowish brown (10YR 6/4) sandstone, dark yellowish brown (10YR 4/4) moist; common fine roots in cracks.

The A1 horizon is pale brown or very pale brown (10YR 6/3, 7/3). Reaction is medium acid or slightly acid.

The B2 horizon is mainly light yellowish brown, yellowish brown, or brownish yellow (10YR 6/4, 5/4, and 6/6) clay loam, but it is loam in some pedons. Reaction is slightly acid or medium acid.

Depth to sandstone or shale is 10 to 20 inches.

164—Millsholm loam, 15 to 30 percent slopes. This gently sloping to moderately steep soil is on toe slopes and side slopes on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Diablo, Haire, Fagan, and Maymen soils. Also included were small areas of soils that are subject to a moderate hazard of sheet and rill erosion, areas of soils that have a fine sandy loam surface layer, areas of soils that are strongly acid in places, and areas of soils that are less than 10 inches deep to bedrock.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used mostly for range. Some areas in the southwestern part of Napa County are used for dairy pasture. Capability unit VIe–1 (15); Shallow Fine Loamy range site.

165—Millsholm loam, 30 to 75 percent slopes. This steep and very steep soil is on uplands.

Included with this soil in mapping were small areas of Bressa, Dibble, Fagan, and Maymen soils. Also included were areas of Millsholm soils that are subject to a moderate hazard of sheet and rill erosion, areas of soils that have a fine sandy loam surface layer, areas of soils that are strongly acid in some places, and areas of soils that are less than 10 inches deep to bedrock.

Runoff is very rapid. The hazard of erosion is high.

This soil is used for range. Capability unit VIIe–1 (15); Shallow Fine Loamy range site.

Montara series

The Montara series consists of well drained soils on uplands. Slope is 5 to 50 percent. Elevation is 500 to 1,500 feet. These soils formed in material weathered from serpentine. The vegetation consists mainly of an-

nual grasses and a few digger pine. The mean annual precipitation is 25 to 45 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 240 to 260 days.

In a representative profile the surface layer is grayish brown and dark grayish brown mildly alkaline clay loam underlain at a depth of 12 inches by serpentine.

Permeability is moderately slow. The effective rooting depth is 10 to 15 inches. Available water capacity is 2 to 2.5 inches.

Montara soils are used mostly for wildlife habitat and watershed. Areas of Montara soils that adjoin areas of other soils that are in pasture are used for grazing.

Representative profile of Montara clay loam, 5 to 30 percent slopes, approximately ¼ mile northwest of intersection of Snell Valley and Spanish Trail Roads, SE¼NW¼ sec. 22, T 10 N., R. 5 W.:

A11—0 to 4 inches, grayish brown (10YR 5/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine roots; many very fine tubular pores; mildly alkaline (pH 7.8); clear wavy boundary.

A12—4 to 12 inches, dark grayish brown 2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate coarse subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; many very fine tubular pores; mildly alkaline (pH 7.8); abrupt wavy boundary.

R—12 inches, serpentine.

The A horizon is gray, grayish brown, or dark grayish brown (10YR 5/2, 4/2, and 5/1 and 2.5Y 5/2, 4/2). Reaction is neutral to moderately alkaline. Depth to bedrock is 10 to 15 inches. Gravel and cobbles that are mainly serpentine make up 5 to 10 percent of the profile.

166—Montara clay loam, 5 to 30 percent slopes. This gently sloping to moderately steep soil is on foot slopes, side slopes, and rounded ridgetops on uplands. It has the profile described as representative for the Montara series.

Included with this soil in mapping were areas of Henneke and Maxwell soils. Also included were areas of rock outcrop and areas of soils that are similar to this Montara soil but that are clayey or that are less than 10 inches deep to bedrock.

Runoff is rapid. The hazard of erosion is moderate.

This soil is used for range, wildlife habitat, and watershed. Capability unit VIIe-1 (15); Serpentine range site.

167—Montara clay loam, 30 to 50 percent slopes. This steep soil is on uplands.

Included with this soil in mapping were small areas of Bressa, Henneke, and Lodo soils and areas of soils that are similar to this Montara soil but that are clayey.

Runoff is rapid. The hazard of erosion is high.

This soil is used for wildlife habitat, limited grazing, and watershed. Capability unit VIIe-1 (15); Serpentine range site.

Perkins series

The Perkins series consists of well drained soils on terraces. Slope is 2 to 9 percent. Elevation is 150 to 1,500 feet. These soils formed from alluvium derived from igneous rock. The vegetation consists of oak-grass in natural state and orchards and vineyards where the soils are cultivated. The mean annual precipitation is 30 to 40 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is brown, slightly acid gravelly loam 19 inches thick. The subsoil is reddish brown, slightly acid gravelly clay loam 38 inches thick. The substratum is brown slightly acid gravelly loam to a depth of 60 inches.

Permeability is slow. The effective rooting depth is 50 to 60 inches. Available water capacity is 7.5 to 8.5 inches.

Perkins soils are used for vineyards and orchards where the soils are cultivated, and they are used for grazing areas that have an oak-grass cover.

Representative profile of Perkins gravelly loam, 5 to 9 percent slopes, about 4,600 feet south on Silverado Trail from Yountville Cross Road and 50 feet west of Silverado Trail, T. 7 N., R. 4 W. (nonsectionalized):

A11—0 to 7 inches, brown (7.5YR 5/4) gravelly loam, dark reddish brown (5YR 3/4) moist; moderate medium granular and subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine tubular and vesicular pores; 20 percent gravel; slightly acid (pH 6.2); clear wavy boundary.

A12—7 to 19 inches, brown (7.5YR 5/4) gravelly loam, dark reddish brown (5YR 3/4) moist; moderate medium granular and subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine tubular and vesicular pores; few thin discontinuous clay films on peds; 25 percent gravel; slightly acid (pH 6.5); gradual smooth boundary.

B1t—19 to 29 inches, reddish brown (5YR 4/4) gravelly loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure that parts to moderate fine and medium granular; slightly hard, friable, slightly sticky and nonplastic; many very fine and fine roots; many very fine and fine tubular and vesicular pores; common thin discontinuous clay films on peds, lining pores, and as bridges; 20 percent gravel; slightly acid (pH 6.5); gradual smooth boundary.

B21t—29 to 44 inches, reddish brown (5YR 5/4) gravelly clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure that parts to moderate fine and medium granular; hard, friable, slightly sticky and slightly plastic; very few coarse and many fine and very fine roots; few fine tubular and many vesicular pores; common thin continuous clay films on peds, lining

pores, and as bridges; 20 percent gravel; slightly acid (pH 6.5); gradual smooth boundary.

B22t—44 to 57 inches, reddish brown (5YR 5/4) gravelly clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure that parts to moderate fine and medium granular; hard, friable, slightly sticky and slightly plastic; few coarse and common very fine and fine roots; few fine tubular and many vesicular pores; common thin discontinuous clay films on peds, lining pores, and as bridges; 20 percent gravel; slightly acid (pH 6.5); diffuse wavy boundary.

C—57 to 60 inches, brown (7.5YR 5/4) gravelly loam, reddish brown (5YR 3/4) moist, moderate medium subangular blocky structure that parts to weak fine and medium granular; hard, friable, slightly sticky and slightly plastic; few coarse and common very fine and fine roots; few fine tubular and many vesicular pores; common thin discontinuous clay films on peds, lining pores, and as bridges; many shale and mixed volcanic fragments; 30 percent gravel; slightly acid (pH 6.5).

The A horizon is brown or reddish brown (7.5YR 5/4 and 5YR 5/4, 4/4) gravelly loam. It is 15 to 35 percent gravel.

The Bt horizon is reddish brown (5YR 5/4, 5/3, and 4/4) gravelly loam or gravelly clay loam. It is 15 to 20 percent gravel.

The C horizon is brown and reddish brown (7.5YR 5/4 and 5YR 5/4, 4/4) gravelly loam. It is 15 to 40 percent gravel. In some pedons, the C horizon is partly indurated or cemented. Depth to weathered mixed alluvium ranges from 50 to 60 inches.

The Perkins soils in Napa County do not have the massive A horizon that is in the range defined for the series. This difference, however, does not alter the use and behavior of the soils.

168—Perkins gravelly loam, 2 to 5 percent slopes. This gently sloping soil is on old terraces and alluvial plains.

Included with this soil in mapping were small areas of Bale, Coombs, and Haire soils.

Runoff is slow. The hazard of erosion is slight.

This soil is used for vineyards and orchards and for hay where the soil is not cultivated. Capability unit IIe–3 (14).

169—Perkins gravelly loam, 5 to 9 percent slopes. This moderately sloping soil is on old terraces. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bale and Haire soils. Also included were small areas of very gravelly soils.

Runoff is medium. The hazard of erosion is slight.

This soil is mainly used for vineyards and orchards. Areas of this soil that are adjacent to other soils that are in pasture are used for grazing. Capability unit IIe–3 (14).

Pleasanton series

The Pleasanton series consists of well drained soils on alluvial fans. Slope is 0 to 5 percent. Elevation is 50 to 600 feet. These soils formed in alluvium derived from sedimentary rock. The native vegetation consists mainly of annual grasses and scattered oaks. Mean annual precipitation is 25 to 35 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is grayish brown, strongly acid loam and brown, medium acid loam 11 inches thick. The subsoil is dark grayish brown and brown, medium acid heavy loam 49 inches thick. The substratum is dark yellowish brown slightly acid heavy loam to a depth of 66 inches.

Permeability is moderately slow. The effective rooting depth is 60 inches or more. The available water capacity is 8 to 9 inches.

Pleasanton soils are used for dryland and irrigated pasture, orchards, and vineyards.

A representative profile of Pleasanton loam, 0 to 2 percent slopes, 800 feet west of State Highway 29 and 1,500 feet south of Darms Lane, R. 4 W., T. 6 N. (nonsectionalized):

Ap—0 to 5 inches, grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine interstitial pores; strongly acid (pH 5.5); clear smooth boundary.

A12—5 to 11 inches, brown (10YR 4/3) loam, very dark gray (10YR 3/1) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and common fine tubular and interstitial pores; medium acid (pH 6.0); clear wavy boundary.

B21t—11 to 19 inches, dark grayish brown (10YR 4/2) loam, very dark gray (10YR 3/1) moist; massive; hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; common fine and medium interstitial and tubular pores; few thin clay films lining pores; medium acid (pH 6.0); clear smooth boundary.

B22t—19 to 38 inches, brown (10YR 4/3) loam, very dark gray (10YR 3/1) moist; weak fine angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; common fine tubular and interstitial pores; common thin clay films on peds; medium acid (pH 6.0); clear smooth boundary.

B23t—38 to 54 inches, brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; weak fine angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; common very fine tubular and interstitial pores; common thin clay films on peds and as bridges; medium acid (pH 6.0); gradual wavy boundary.

B24t—54 to 60 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak fine

subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and few medium roots; few medium and common fine tubular and interstitial pores; few thin clay films on peds and as bridges; slightly acid (pH 6.3); gradual wavy boundary.

C—60 to 66 inches, dark yellowish brown (10YR 4/4) loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; slightly acid (pH 6.5).

The A horizon is mainly grayish brown or brown (10YR 5/2, 5/3, and 4/3) loam, but it is clay loam in some small areas. Reaction is slightly acid or medium acid.

The B2t horizon is dark grayish brown, dark brown, brown, or dark yellowish brown (10YR 4/2, 4/3, 4/4, and 5/3) loam or clay loam. The lower part of the B horizon is commonly stratified. Reaction is slightly acid or medium acid.

The C horizon is typically yellowish brown and dark yellowish brown (10 YR 5/4, 5/6, 5/8, and 4/4) loam or sandy loam.

Pleasanton soils in Napa County are more acid than is defined in the range for the series. This difference, however, does not greatly alter the use and management of the soils.

170—Pleasanton loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans and flood plains. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Cole, Cortina, and Yolo soils and small areas of soils that have a clayey subsoil.

Runoff is slow. The hazard of erosion is slight.

This soil is used mainly for pasture and prunes, but the acreage is being planted to vineyards. Capability unit I (14).

171—Pleasanton loam, 2 to 5 percent slopes. This gently sloping soil is on alluvial fans.

Included with this soil in mapping were small areas of Cole, Perkins, Maxwell, and Yolo soils.

Runoff is slow. The hazard of erosion is slight.

This soil is used for pastures in areas in Pope Valley. Areas of this soil in Napa Valley are being planted to vineyards. Capability unit IIe–1 (14).

Reyes series

The Reyes series consists of poorly drained soils in basins and on tidal flats. Slope is 0 to 2 percent. Elevation ranges from a few feet above to a few feet below sea level. These soils formed in mixed alluvium from sedimentary and basic rock. The vegetation is tule, saltgrass, and other water-loving plants. The mean annual precipitation is 20 to 25 inches, and the mean annual temperature is 59° to 61° F. Summers are hot and dry, and winters are cool and moist.

In a representative profile the surface layer is light brownish gray and gray, very strongly acid silty clay loam 14 inches thick. The subsoil is pinkish gray, very strongly acid mucky silty clay loam 10 inches thick. The substratum is light gray, very strongly acid silty clay loam to a depth of 60 inches or more. It is underlain by stratified, mixed marine sediments.

Permeability is slow. The effective rooting depth is 60 inches or more. Available water capacity is 8 to 12 inches.

Reyes soils are used for salt basins and for oats, hay, and grain where the soils are diked.

Representative profile of Reyes silty clay loam, ½ mile southeast of Cuttings Wharf on Bull Island, SE¼SE¼ sec. 34, T. 4 N., R. 4 W.:

Ap—0 to 8 inches, light brownish gray (2.5Y 6/2) silty clay loam and common fine faint light yellowish brown (2.5Y 6/4) mottles; very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; very strongly acid (pH 4.5); abrupt wavy boundary.

A12g—8 to 14 inches, gray (10YR 5/1) silty clay loam and common fine distinct dark brown (10YR 3/3) mottles; black (10YR 2/1) moist; moderate medium granular structure; hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; very strongly acid (pH 4.5); clear smooth boundary.

B2g—14 to 24 inches, pinkish gray (7.5YR 6/2) mucky silty clay loam and common fine distinct dark reddish brown (5YR 2/2) mottles; very dark brown (7.5YR 2/2) moist; weak thick platy structure; hard, firm, sticky and plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; very strongly acid (pH 4.5); clear wavy boundary.

C1g—24 to 34 inches, light gray (10YR 6/1) silty clay loam and few fine prominent strong brown (7.5YR 5/8) mottles; dark gray (10YR 4/1) moist; massive; hard, firm, sticky and plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; very strongly acid (pH 4.5); clear wavy boundary.

IIC2g—34 to 60 inches, light gray (5Y 6/1) silty clay loam and common fine prominent yellowish red (5YR 4/6) mottles; dark gray (5Y 4/1) moist; massive; hard, firm, sticky and plastic; many very fine and fine roots; many very fine and fine tubular and interstitial pores; very strongly acid (pH 4.5).

The A horizon is mainly silty clay loam, but it is silty clay in some pedons. Reaction is generally very strongly acid or extremely acid, but it ranges to moderately alkaline in salt beds. In places, strata of peat and muck are in the lower part of the A horizon.

The C horizon is pinkish gray, light gray, or gray (7.5YR 6/2, 10YR 6/1, 5YR 6/1, and N 6/) silty clay loam or silty clay. Reaction is moderately alkaline to very strongly acid. Strata of peat and muck are in some pedons. In some pedons, the soil material has a

strong hydrogen sulfide odor at a depth of more than 30 inches.

172—Reyes silty clay loam. This nearly level soil is in basins and on tidal flats. It has the profile described as representative for the Reyes series.

Included with this soil in mapping were small areas of Clear Lake and Haire soils. Also included were small areas of soils that have a loam or silt loam overwash and areas of saline soils.

Runoff is slow. The hazard of erosion is slight.

This soil has a fluctuating water table, but the water table is at a depth of 2 to 5 feet during the dry part of the year and is at a depth of less than 2 feet during winter and early in spring.

This soil is used for oats, hay, and grain where the areas are diked. Capability unit IVw–9 (14).

173—Reyes silty clay loam, salt ponds. This soil has been diked for use as evaporation ponds for salt production. The ponds are along tidal flats and basins adjacent to San Pablo Bay. Capability unit VIIIw–1 (14).

Riverwash

174—Riverwash. These miscellaneous areas are in active stream channels, on flood plains, and adjacent to drainageways. Slope is 0 to 5 percent. Elevation is 200 to 1,500 feet. The areas are inundated during periods of waterflow and are subject to constant deposition and removal of material. Vegetation consists of occasional willows, water grasses, and some brush.

Riverwash consists of erratically stratified layers of water-deposited sand, gravel, stones, and cobbles. Layers of sandy loam and silt loam are deposited for short periods but are subject to intermittent scouring and removal. Thickness of the strata ranges from 2 to 30 inches. Reaction is neutral or mildly alkaline. The organic matter content varies from stratum to stratum but is commony low.

Included with Riverwash in mapping were small areas of Cortina soils.

Runoff is slow. The hazard of erosion is slight to very severe, depending on water velocity.

Riverwash is used as a source of sand and gravel. It is almost devoid of vegetation and has no agricultural use. Capability unit VIIIw–1 (14).

Rock outcrop

175—Rock outcrop consists of ridges of igneous bedrock and of outcrops of sandstone and shale in the Blue Ridge area bordering Yolo County. The areas are more than 90 percent Rock outcrop and less than 10 percent areas of soil material that is less than 6 inches deep. The vegetation consists of small shrubs and a few stunted trees in cracks between lichen-covered rocks.

Runoff is very rapid. The hazard of erosion is high.

This miscellaneous area is used for watershed, wildlife habitat, and recreation. Capability unit VIIIs–1 (15).

176—Rock outcrop-Hambright complex, 50 to 75 percent slopes. This complex consists of areas of Rock outcrop and soils on south-facing slopes. Elevation is 1,000 to 3,000 feet. The areas of Rock outcrop and soils are so intermingled that it was not practical to separate them at the scale used in mapping. The soils formed in material weathered from fine grained basic igneous material.

This complex is about 60 percent Rock outcrop, 30 percent Hambright soils, and 10 percent Guenoc and Kidd soils. Rock outcrop is in areas 1 to 5 acres in size. It consists of basic igneous boulders, stones, and outcrops.

Runoff is very rapid. The hazard of erosion is high.

This complex is used for watershed and wildilfe habitat. Capability unit VIIIs–1 (15).

177—Rock outcrop-Kidd complex, 50 to 75 percent slopes. This complex consists of areas of Rock outcrop and soils on south-facing slopes. Elevation is 1,000 to 3,000 feet. The areas of Rock outcrop and soils are so intermingled that it was not practical to map them separately at the scale used in mapping. The soils formed in material weathered from basic igneous rock and rhyolite.

This complex is about 70 percent Rock outcrop, 25 percent Kidd soils, and 5 percent Hambright, Boomer, and Forward soils. Rock outcrop is in areas 1 to 5 acres in size. It consists of basic igneous boulders and massive rhyolitic escarpments, stones, and outcrops.

Runoff is rapid. The hazard of erosion is very high.

This complex is used for wildlife habitat and watershed. Capability unit VIIIs–1 (15).

Sobrante series

The Sobrante series consists of well drained soils on uplands. Slope is 5 to 50 percent. Elevation is 400 to 2,000 feet. These soils formed in material weathered from sandstone. The vegetation is mostly annual grasses, scattered oaks, and a few digger pine. The mean annual precipitation is 25 to 35 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is brown, slightly acid loam 6 inches thick. The subsoil is reddish yellow, light brown, and pink, medium acid clay loam 24 inches thick. Massive sandstone is at a depth of 30 inches.

Permeability is moderate. The effective rooting depth is 25 to 40 inches. Available water capacity is 4 to 6 inches.

Sobrante soils are used mostly for grazing. Some small areas are used for recreation and wildlife habitat.

Representative profile of Sobrante loam, 30 to 50 percent slopes, 5,400 feet north on Chiles Valley Road from intersection with Pope Canyon Road and 100 feet west of Chiles Valley Road, NW¼SE¼ sec. 21 (projected), T. 9 N., R. 5 W.:

A11—0 to 4 inches, brown (7.5YR 5/4) loam, dark reddish brown (5YR 3/4) moist; strong fine and medium granular structure; soft, friable, slightly sticky and slightly plastic; few coarse and many very fine and fine roots; many fine and medium tubular pores; slightly acid (pH 6.5); clear wavy boundary.

A12—4 to 6 inches, brown (7.5YR 5/4) loam, dark reddish brown (5YR 3/4) moist; strong medium granular and subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few coarse and many very fine and fine roots; many fine and medium tubular pores; medium acid (pH 6.0); gradual wavy boundary.

B21t—6 to 15 inches, reddish yellow (7.5YR 6/6) clay loam, reddish brown (5YR 4/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common coarse and medium roots; many fine and medium tubular pores; few thin clay films on peds and lining pores; medium acid (pH 6.0); gradual wavy boundary.

B22t—15 to 21 inches, light brown (7.5YR 6/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; few medium roots; many fine and medium tubular pores; few thin clay films on peds and lining pores; medium acid (pH 5.8); gradual wavy boundary.

B23t—21 to 30 inches, pink (7.5YR 7/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; few medium roots; many fine and medium tubular pores; few thin clay films on peds and lining pores; medium acid (pH 6.0); gradual irregular boundary.

R—30 inches, massive fine grained sandstone.

The A horizon is brown (7.5YR 5/2, 5/4) loam or clay loam.

The upper part of the B horizon is reddish yellow, light reddish brown, or light brown (5YR 6/3, 6/4, and 6/6 and 7.5YR 6/6). The lower part is pink, light brown, or reddish yellow (7.5YR 7/4, 7/6, 7/8, 6/4, 6/6, and 6/8). Reaction is slightly acid or medium acid. Depth to massive sandstone is 25 to 40 inches.

Sorbante soils in Napa County are outside of the range defined for the Sobrante series because they are less than 40 inches deep to bedrock and they lack hue of 5YR and 2.5 YR in the Bt horizon.

178—Sobrante loam, 5 to 30 percent slopes. This moderately sloping to moderately steep soil is on foot slopes and side slopes on uplands.

Included with this soil in mapping were small areas of Bressa, Dibble, Felton, Forward, Lodo, and Maymen soils. Also included were areas of soils that are similar to this Sobrante soil but that are neutral in reaction or that have a reddish clay subsoil.

Runoff is medium. The hazard of erosion is slight to moderate.

This soil is used for range. Some areas of less sloping soils in Mt. Veeder area are used for orchards. Capability unit IVe–1 (15); Loamy Upland range site.

179—Sobrante loam, 30 to 50 percent slopes. This steep soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bressa, Dibble, Forward, Henneke, Lodo, and Maymen soils. Also included were areas of soils that have a reddish clay subsoil.

Runoff is rapid. The hazard of erosion is moderate to high.

This soil is used for range and watershed. Capability unit VIe–1 (15); Loamy Upland range site.

Tehama series

The Tehama series consists of well drained soils on alluvial fans and terraces. Slope is 0 to 5 percent. Elevation is 200 to 500 feet. These soils formed in alluvium from sandstone and shale. The plant cover is annual grasses, forbs, and scattered oak. The mean annual precipitation is 25 to 35 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters are cool and moist. The frost-free season is 250 to 260 days.

In a representative profile the surface layer is pale brown, slightly acid silt loam 12 inches thick. The subsoil is brown and dark grayish brown, neutral and mildly alkaline silty clay loam to a depth of 60 inches or more.

Permeability is slow. The effective rooting depth is 60 inches or more. Available water capacity is 10 to 12 inches.

Tehama soils are used mostly for pasture.

Representative profile of Tehama silt loam, 0 to 5 percent slopes, on the east shore of Lake Berryessa, 1¼ miles south of old county road from intersection with Berryessa-Knoxville Road, 50 feet west of old county road and 50 feet south of drainageway, T. 10 N., R. 4 W. (nonsectionalized):

A11—0 to 4 inches, pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate medium angular and subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular and interstitial pores; slightly acid (pH 6.5); clear smooth boundary.

A12—4 to 12 inches, pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate medium angular and subangular blocky structure; extremely hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular and interstitial pores; slightly acid (pH 6.2); gradual wavy boundary.

B1t—12 to 26 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium angular and subangular blocky structure; extremely hard, friable, sticky and plastic; many very fine roots; many very fine tubular and interstitial pores; many thin clay films on peds and lining pores; neutral (pH 6.8); gradual wavy boundary.

B21t—26 to 35 inches, dark grayish brown and dark brown (10YR 4/2, 4/3) silty clay loam, dark brown (10YR 3/3) moist; weak coarse angular blocky structure; extremely hard, firm, sticky and plastic; many very fine roots;

many very fine tubular and interstitial pores; many thin clay films on peds and lining pores; neutral (pH 7.0); diffuse wavy boundary.

B22t—35 to 45 inches, dark grayish brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) moist; strong coarse and very coarse angular blocky and weak medium prismatic structure; extremely hard, firm, sticky and plastic; many very fine roots; many very fine tubular and interstitial pores; many moderately thick clay films on peds and lining pores; neutral (pH 7.3); diffuse wavy boundary.

B23t—45 to 60 inches, dark grayish brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) moist; strong coarse and very coarse angular blocky and weak medium prismatic structure; extremely hard, firm, sticky and plastic; many very fine roots; many very fine tubular and interstitial pores; many moderately thick clay films on peds and lining pores; mildly alkaline (pH 7.6).

The A1 horizon is light brownish gray, pale brown, light gray, or very pale brown (10YR 6/2, 6/3, 7/2, and 7/3) loam or silt loam.

The B2t horizon is brown, dark brown, grayish brown, or dark grayish brown (10YR 5/3, 4/3, and 4/2 and 2.5Y 4/2 and 5/2). It is mainly silty clay loam, but in small areas it is clay or silty clay. Depth to weathered alluvium is 60 inches or more.

180—Tehama silt loam, 0 to 5 percent slopes. This nearly level to gently sloping soil is on old alluvial fans and terraces.

Included with this soil in mapping were small areas of Bressa, Cole, Dibble, and Yolo soils.

Runoff is medium. The hazard of erosion is slight.

This soil is used mainly for pasture. Some small areas are included with adjacent soils in vineyards. Capability unit IIe-3 (14).

Yolo series

The Yolo series consists of well drained soils on alluvial fans. Slope is 0 to 5 percent. Elevation ranges from near sea level to 500 feet. These soils formed from recent alluvium. The vegetation consists mostly of vineyards and small areas of pasture and prune orchards. The mean annual precipitation is 25 to 40 inches, and the mean annual temperature is 59° to 62° F. Summers are hot and dry, and winters cool and moist. The frost-free season is 220 to 260 days.

In a representative profile the surface layer is dark grayish brown, neutral loam and silt loam 24 inches thick. The underlying material is dark grayish brown and brown, neutral silt loam to a depth of 60 inches or more.

Permeability is moderate. The effective rooting depth is 60 inches or more. Available water capacity is 10 to 12 inches.

Yolo soils are used for vineyards, orchards, and pasture.

Representative profile of Yolo loam, 0 to 2 percent slopes, 50 feet east of Napa River and 100 feet south of Oakville Cross Road, NW¼SE¼ sec. 22, R. 5 W., T. 7 N.:

Ap—0 to 6 inches, dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine and medium tubular and interstitial pores; neutral (pH 6.7); diffuse smooth boundary.

A12—6 to 24 inches, dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; extremely hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine and medium tubular and interstitial pores; neutral (pH 6.7); diffuse smooth boundary.

C1—24 to 45 inches, dark grayish brown (10YR 4/2) silt loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few coarse and common fine and medium roots; many fine and medium tubular and interstitial pores; neutral (pH 6.7); diffuse smooth boundary.

C2—45 to 60 inches, brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few coarse and common fine and medium roots; many fine and medium tubular and interstitial pores; neutral (pH 6.7).

The A horizon is brown, grayish brown, or dark grayish brown (7.5YR 5/2 and 10YR 4/2, 5/2). Reaction is slightly acid or neutral.

The C horizon is brown, dark grayish brown, or grayish brown (10YR 5/3, 4/3, 5/2, and 4/2) silt loam or silty clay loam. Reaction is slightly acid to mildly alkaline.

181—Yolo loam, 0 to 2 percent slopes. This nearly level soil is on alluvial fans. It has the profile described as representative for the series.

Included with this soil in mapping were small areas of Bale, Cole, Cortina, and Pleasanton soils.

Runoff is slow. The hazard of erosion is slight.

This Yolo soil is used for vineyards, orchards, and irrigated pasture. Capability unit I (14).

182—Yolo loam, 2 to 5 percent slopes. This gently sloping soil is on alluvial fans.

Included with this soil in mapping were small areas of Bale, Cole, Cortina, and Pleasanton soils.

Runoff is slow. The hazard of erosion is slight.

This soil is used for vineyards, orchards, and irrigated pasture. Capability unit IIe-1 (14).

Use and management of the soils

In this section the system of capability classification used by the Soil Conservation Service is explained with modifications that are necessary because of climatic differences in the three land resource areas in Napa County. Then the capability units are described and suggestions for managing the soils in each capability unit are given. Next, yields of the principal crops

grown in the country are estimated for those soils that are widely used for crops, and management is given for each of the major crops. Management by range site and by woodland group are described, and use of the soils for wildlife habitat, recreation, and engineering are discussed.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth or other characteristics of the soils; does not take into consideration possible, but unlikely, major reclamation projects; and does not apply to crops requiring special management.

Those familiar with capability classification can infer from it much about the behavior of the soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, for engineering, or for other uses.

In the capability system all kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed 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 uses, 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, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, 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 largely to pasture, range, woodland, or wildlife habitat (none in Napa County).

Class VI soils have severe limitations that make them generally unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter *e, w, s,* or *c* to the class numeral, for example IIe. The letter *e* shows that the main limitation is a risk of erosion unless close growing plant cover is maintained; *w* shows that the water in or on the soil interfers with plant growth and 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, clayey, droughty, or stony; and *c,* used only in some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at most, only the subclasses indicated by *w, s,* and *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils.

Capability units in California in classes I through IV are given Arabic numbers that suggest the chief kind of limitation responsible for placement of the soil in the capability class and subclass. For this reason, some of the units within the subclass are not numbered consecutively, and their symbols are a partial key to some of the soil features. The numbers used to designate units within the subclasses are these:

0. A problem or limitation caused by sand or gravel in the substratum (not used in this county).
1. An actual or potential erosion hazard.
2. A problem or limitation of wetness by poor drainage or flooding.
3. A problem or limitation caused by slow or very slow permeability of the subsoil or substratum.
4. A problem or limitation caused by coarse soil texture or excessive gravel.
5. A problem or limitation caused by moderately fine or fine texture soil.
6. A problem or limitation caused by salt or alkali (not used in this county).
7. A problem or limitation caused by cobblestones, other stones, or rock outcrop (not used in this county).
8. A problem or limitation caused by a shallow depth of soil over bedrock or hardpan (not used in this county).
9. A problem or limitation caused by low fertility, acidity, or toxicity.

Capability units in Classes V through VIII are given the nonconnotative number 1 as unit designator.

Land resource areas

In Napa County, capability classification is further refined by designating the land resource area in which the soils in a unit occur. A land resource area is a broad geographic area that has a distinct combination of cli-

mate, soils, vegetation, management needs, and kinds of crops that can be grown (*3*). Parts of three of these are in Napa County: Siskiyou-Trinity (5), Central California Valleys (14), and Central California Coast Range (15). The number of the resource area is added in parentheses to the unit designation, for example IIIe–1 (14).

Land resource area 5. This resource area makes up about 10 percent of the county. It includes the forested mountains in the northwestern and north-central parts of the county. These soils are mostly moderately sloping to very steep. Elevation ranges from 500 to 4,000 feet. Precipitation ranges from 35 to 40 inches. Most of the conifer production is in this area. Some of the open areas are used for range.

Land resource area 14. Only the valley parts of the county are in this resource area. This area makes up about 15 percent of the county. The soils are nearly level to hilly. Elevation ranges from 20 to 500 feet. Precipitation ranges from 25 to 35 inches, but less than 1 inch falls in summer. Most of the level soils in this resource area are irrigated and are intensely cultivated. Most of the acreage is in wine grapes. Pasture and orchards occupy the remaining acreage. The land capability classification for soils in this area is based on the assumption that water is available for irrigation. Some of the areas immediately adjacent to the Napa River are subject to infrequent overflow.

Land resource area 15. This resource area makes up about 75 percent of the county. It includes the mountains in the eastern, northern, and southwestern parts of the county. The soils are mostly moderately sloping to very steep, though in a few mountain valleys the soils are nearly level. Elevation ranges from 500 to 3,000 feet. Precipitation ranges from 25 to 35 inches, but less than 1 inch falls in summer. Dryland grain and pasture are the main crops on the nearly level soils. The steeper soils are used mainly for range. It is assumed that water is not available for irrigation on a commercial basis. The soils in this resource area are classified on their potential for dryland farming.

Management by capability units

In the following pages the capability units in Napa County are described, and suggestions for use and management of the soils are given. Soil series are mentioned in each capability unit, but this does not mean that all mapping units of the series are in that particular unit. The unit for each soil is given in the "Guide to Mapping Units" at the back of the survey.

Practices vary with particular crops and soils but certain standard practices apply to all units. The following practices are examples of these:

1. Returning all crop residue to the soil helps to maintain tilth.
2. Minimum tillage reduces soil compaction and improves water intake.
3. Erosion control, tilth, and water intake of all soils are improved by such practices as growing cover crops, mulching, and minimum tillage.

Capability unit I (14)

This unit consists of well drained soils of the Pleasanton and Yolo series. These soils are generally on alluvial fans. Slope is less than 2 percent. Soil depth is 60 inches or more. The surface layer is loam. In places the soils are stratified, but the texture of the layers is neither fine enough nor coarse enough to impair root penetration or moisture storage.

Available water capacity is 8 to 12 inches. Reaction is medium acid to neutral. Permeability is moderate to moderately slow.

These soils are suited to all cultivated crops grown in the county. They are also suited to hay and pasture.

Soils in this unit respond well to good management. There is little or no hazard of erosion. Some flooding occurs occasionally in very small areas, but no special management is required.

Capability unit IIe–1 (14)

This unit consists of well drained soils of the Pleasanton and Yolo series. These soils are on alluvial fans. Slope is 2 to 5 percent. Soil depth is more than 60 inches. The surface layer is loam.

Available water capacity is 8 to 12 inches. Reaction is medium acid to neutral. Permeability is moderate or moderately slow.

These soils are suited to all cultivated crops grown in the county. They are also suited to hay and pasture.

Soils in this unit are fertile and easy to till. They respond to good management, including use of fertilizer. The hazard of erosion can be reduced by tilling across the slope.

Capability unit IIe–3 (14)

This unit consists of well drained soils of the Perkins and Tehama series. These soils are on alluvial fans and terraces. Slope is 0 to 9 percent. These soils formed in partly consolidated terrace gravel and in alluvium. Depth to weakly cemented material ranges from 50 to 60 inches or more in the soils that formed in terrace gravel. In the soils that formed in alluvium, the depth to weakly cemented material is more than 60 inches. The surface layer is gravelly loam or silt loam.

Available water capacity is 7.5 to 12 inches. Reaction is slightly acid to mildly alkaline. Permeability is slow in the subsoil.

These soils are suited to most crops grown in Napa County.

Irrigation water must be applied carefully to avoid building up a perched water table. Deep cuts should be avoided. All tillage should be across the slope.

Capability unit IIe–5 (15)

This unit consists of Diablo clay, 5 to 9 percent slopes. This well drained soil is on foot slopes. Sandstone is at a depth of 40 to 80 inches.

Available water capacity is 6 to 10 inches. As this soil dries, wide cracks form in the surface. The soil absorbs moisture rapidly until the cracks close; then intake and permeability become slow. This soil is slow to warm in spring.

This soil is better suited to hay and forage than to other crops.

Preparing a seedbed in this soil is difficult because large clods form unless the soil is worked at the proper moisture content. Cultivating across the slope reduces erosion and slippage. Crops respond to nitrogen fertilizer.

Capability unit IIw–2 (14)

This unit consists of somewhat poorly drained Bale and Cole soils. Slope is 0 to 5 percent. In places these soils are stratified or have a fine textured layer at a depth of 40 to more than 60 inches. The surface layer is loam, silt loam, or clay loam.

Available water capacity in drained areas is 6 to 12 inches. Reaction is slightly acid to moderately alkaline. Permeability is moderately slow or moderate. In places the water table is at a depth of 3 to 5 feet for part of some years. These soils are subject to infrequent flooding in some areas. Some of the soils are subject to deposition of sediment.

If drained, these soils are well suited to most field, forage, row, and truck crops. If not artificially drained, most of the soils are poorly suited to trees and vineyards.

These soils are tillable. They respond to good management. Where the water table is sometimes above a depth of 5 feet, tile drains or open ditches are needed to lower the water table.

Capability unit IIs–5 (14)

This unit consists of Clear Lake clay, drained. This soil formed under poor drainage conditions, but the water table is now maintained below a depth of 5 feet and is no longer a problem. This soil formed in alluvium in basins and valleys. Slope is 0 to 2 percent.

Effective rooting depth is 60 inches or more. Available water capacity is 8 to 10 inches. Reaction is slightly acid to moderately alkaline. Permeability is slow.

This soil is well suited to field, row, forage, and truck crops that are adapted to slowly permeable clay soils.

Irrigation water should be applied slowly to avoid excess runoff and to conserve water. The soil is difficult to cultivate unless it is worked at the proper moisture content. If worked when too wet, the surface slicks over and seals against water infiltration. If cultivated when too dry, large very hard clods form.

Capability unit IIIe–1 (5)

This unit consists of well drained Aiken, Boomer, and Forward soils. These soils are on low hills and benches. Slope is 2 to 15 percent. Bedrock is at a depth of 20 to 60 inches. The surface layer is gravelly loam or loam.

Available water capacity is 2.5 to 11 inches. Reaction is slightly acid to strongly acid. Permeability ranges from moderately rapid to moderately slow.

These soils are suited to most field crops grown in the county if adequate erosion control measures are used.

The soils should be tilled and irrigated across the slope or on the contour to reduce the hazard of erosion. Leaving stubble on the surface or keeping plant cover on the soil during the rainy season helps to slow runoff and reduce erosion.

Capability unit IIIe–1 (15)

This unit consists of Bressa-Dibble complex, 5 to 15 percent slopes. These well drained soils formed in material weathered from sandstone and shale. Depth to bedrock, which is also the effective rooting depth, is 20 to 40 inches. The surface layer is silt loam or silty clay loam.

Available water capacity is 4 to 7 inches. Reaction is slightly acid to medium acid. Permeability is moderately slow in the Bressa soil and slow in the Dibble soil.

These soils are suited to field and forage crops and to range.

These soils should be tilled across the slope or on the contour. The soils should be managed as a unit because they are so intermingled that it is not feasible to manage them separately.

Capability unit IIIe–3 (14)

This unit consists of moderately well drained or well drained soils of the Coombs and Haire series. These soils are on old terraces and fans. Slope is 2 to 9 percent. The heavy clay loam or clay subsoil is at a depth of 15 to 40 inches. The surface layer is gravelly loam, loam, or clay loam.

Available water capacity is 3 to 10 inches. Reaction is very strongly acid to medium acid. Permeability is moderately slow to very slow.

These soils are suited to most field and forage crops. The roots of some trees are inhibited by the dense subsoil. In some areas, the soils are suited to special crops such as safflower.

Sprinklers are better suited than other methods for applying irrigation water, though furrows can be used if they are laid across the slope. Crops generally respond to nitrogen and phosphorus fertilizer. Deep cuts should be avoided in smoothing or leveling land.

Capability unit IIIe–3 (15)

This unit consists of Fagan clay loam, 5 to 15 percent slopes. This strongly sloping to moderately sloping soil is on uplands. The clay subsoil is at a depth of 18 to 25 inches, and sandstone is at a depth of 40 to 60 inches.

Available water capacity is 6 to 10 inches. Reaction is medium acid. Permeability is slow.

This soil is suited to range and pasture.

This soil is subject to accelerated erosion if it is not managed properly.

Capability unit IIIe–5 (15)

This unit consists of Diablo clay, 9 to 15 percent slopes. This well drained soil is on low hills and sloping benches. Shale and sandstone are at a depth of 40 to 80 inches.

Available water capacity is 6 to 10 inches. Reaction is medium acid to moderately alkaline. Permeability is slow. Roots and moisture readily penetrate the soil. The hazard of erosion is moderate on cultivated soils.

This soil is well suited to range and pasture.

The fine texture causes problems in cultivation, so special management practices are required for row crops. The soils can be tilled only within a narrow range of moisture content.

Capability unit IIIw–5 (14)

This unit consists of Clear Lake clay, overwashed. This poorly drained soil is at low elevations in basins and valleys. Slope is 0 to 2 percent.

The rooting depth is 60 inches or more. Available water capacity is 8 to 10 inches in drained areas. Reaction is slightly acid to moderately alkaline. Permeability is slow. The water table is commonly at a depth of 3 to 5 feet. This soil is subject to deposition of sediment.

This soil is well suited to certain varieties of field, forage, row, and truck crops.

This soil is difficult to manage because of the clay texture. There is no hazard of erosion. Open ditches or tile drains are needed to lower the water table and keep it below the root zone. In places, root penetration is impeded by the combined effects of the high water table and the slow permeability. Flooding in low areas in valleys late in spring delays planting. Artificial drainage has been provided in some areas.

Capability unit IIIs–3 (14)

This unit consists of moderately well drained and well drained soils of the Coombs and Haire series. Slope ranges from 0 to 2 percent. The surface layer is gravelly loam, loam, or clay loam. The subsoil is clay or heavy clay loam and is at a depth of 10 to 35 inches.

Available water capacity is 3 to 10 inches. Reaction is medium acid to very strongly acid. Permeability of the subsoil is moderately slow to very slow. Roots of most cultivated crops penetrate the clay subsoil.

These soils are suited to small grains and pasture. Potential production for vineyards and orchards is limited.

Irrigation water must be applied very carefully to avoid building up a perched water table. Deep cuts that would expose the subsoil should be avoided.

Capability unit IVe–1 (5)

This unit consists of well drained soils of the Aiken, Boomer, Felta, Felton, and Forward series. These strongly sloping to moderately steep soils are on uplands. Slope ranges from 9 to 30 percent. The soils formed in material weathered from fine-grained sandstone and shale, basic igneous rock, and rhyolite. Bedrock is at a depth of 20 inches to more than 60 inches. The surface layer is loam, gravelly loam, and very gravelly loam.

Available water capacity ranges from 2 to 11 inches. Reaction ranges from strongly acid to neutral. Permeability is moderately rapid to moderately slow.

These soils are suited to dryland and irrigated pasture. Soils on lower side slopes are suited to orchards and vineyards under careful management.

The hazard of erosion is slight to moderate. The soils should be tilled on the contour. In orchards and vineyards where sprinklers are the most efficient method of applying water, a cover crop is needed.

Capability unit IVe–1 (15)

This unit consists of well drained soils of the Bressa, Dibble, Los Gatos, and Sobrante series. These moderately sloping to moderately steep soils are on uplands. Slope ranges from 5 to 30 percent. The soils formed in material weathered from soft or fractured fine-grained sandstone and shale. Bedrock is at a depth of 20 to 40 inches. The surface layer is loam, silt loam, and silty clay loam.

Available water capacity ranges from 3 to 8 inches. Reaction is medium acid to neutral. Permeability is moderate to slow.

These soils are suited to dryland pasture. Suitability for field crops, orchards, and vineyards is marginal because of the low fertility and the water requirements. These crops should be planted only on lower side slopes.

The hazard of erosion is slight to moderate. The soils should be tilled on the contour.

Capability unit IVe–3 (15)

This unit consists of moderately well drained or well drained soils of the Contra Costa, Fagan, and Haire series. Slope ranges from 5 to 30 percent. The surface layer is loam, gravelly loam, or clay loam, and the subsoil is clay.

Available water capacity is 3 to 10 inches. Reaction is neutral to very strongly acid. Permeability is slow or very slow.

These soils are well suited to dryland pasture. Potential production of other crops is limited by the fertility level and the fine textured subsoil.

Irrigation water must be managed very carefully to avoid building up a perched water table. Deep cuts should be avoided in land leveling and smoothing. The soils should be tilled on the contour.

Capability unit IVe–5 (15)

This unit consists of Diablo clay, 15 to 30 percent slopes. This well drained soil is on rounded hills. Sandstone or shale is at a depth of 40 to 80 inches.

Roots penetrate to the bedrock. Available water capacity is 6 to 10 inches. Reaction is medium acid to moderately alkaline. Permeability is slow.

This soil is used mostly for pasture.

This soil is difficult to work because of the fine texture. Management of irrigation water is difficult. Low-volume sprinklers are better suited to this soil than are other methods of applying irrigation water. Erosion control measures must be maintained if the soil is used for field and forage crops.

Capability unit IVw–3 (14)

This unit consists of Egbert silty clay loam. This poorly drained soil is on fans and in basins. The soil formed in alluvium from mixed sources. The underlying material is silty clay loam, silty clay, or clay.

Available water capacity is 10 to 11 inches. Reaction is neutral in the surface layer and moderately alkaline in the underlying material. Permeability is slow. Because of the fine texture and the proximity to waterways, this soil has a fluctuating water table. Salt crystals occur in the underlying material in places.

This soil is well suited to hay and forage crops. This soil is poorly suited to row crops.

Drainage is difficult because of the water table, slow permeability, and inadequate outlets.

Capability unit IVw–9 (14)

This unit consists of Reyes silty clay loam. This poorly drained soil is in low, undulating and irregular areas. In places, thin to thick layers of peat and muck occur throughout the profile.

Available water capacity is 8 to 12 inches. Reaction in the lower layers in reclaimed areas and throughout the profile in unreclaimed areas is very strongly acid. Runoff and permeability are slow. The water table is generally at a depth of 3 to 5 feet. Some salt is in the soil in places, but fresh water from winter rains reduces or neutralizes the harmful effects of excess salt.

This soil is suited only to small grains and forage crops that tolerate salt and acidity. The main crop is oats for hay. Safflower makes fair growth.

There is no hazard of erosion. If this soil is drained, the water table should be lowered only to the minimum depth necessary for shallow-rooted crops. The soil is difficult to rewet after it dries.

Capability unit IVs–4 (14)

This unit consists of somewhat excessively drained Cortina soils. Slope ranges from 0 to 5 percent. These stratified soils formed in alluvium. The soils are more than 60 inches deep. The surface layer is very gravelly loam or very stony loam. The underlying material is very gravelly loamy sand.

Available water capacity is 2 to 5 inches. Reaction is neutral to mildly alkaline. Permeability is rapid. The soils are subject to deposition and removal of material by water.

These soils are suited to vineyards and irrigated pasture.

The low available water capacity is the major limitation on these soils. The soils require light, frequent applications of irrigation water. Crops respond to fertilizer. Tillage is very limited by gravel and stones on the surface.

Capability unit IVs–9 (15)

This unit consists of Maxwell clay, 2 to 9 percent slopes. This somewhat poorly drained soil is in small valleys and on low benches. It formed in alluvium from serpentine.

Effective rooting depth is 60 inches or more. Available water capacity is 10 to 12 inches. Reaction is mildly alkaline to moderately alkaline. Permeability is very slow. Fertility is very low because of calcium deficiency and excess magnesium. The water table is no longer a problem in most areas.

This soil is limited to annual grasses for grazing.

Where water is available, irrigation can be used to increase yields. Use of soil amendments and fertilizer is not economically feasible. Tillage is difficult. The soils can be tilled only within a narrow range of moisture content.

Capability unit VIe–1 (5)

This unit consists of well drained soils of the Aiken, Boomer, Felta, Felton and Forward series. Slope ranges from 30 to 50 percent. The underlying fine grained sandstone and shale or basic igneous bedrock is at a depth of 30 to 60 inches or more. The surface layer is gravelly loam or loam.

Available water capacity is 6 to 11 inches. Reaction is medium acid to neutral. Permeability is moderately slow in the subsoil.

These soils are well suited to timber. In most places the plant cover is coniferous trees such as redwood, Douglas-fir, and ponderosa pine and hardwoods such as tan oak, live oak, madrone, and other broadleaf trees.

The major hazard on these soils is erosion.

Capability unit VIe–1 (15)

This unit consists of moderately well drained and well drained soils of the Bressa, Diablo, Dibble, Fagan, Guenoc, Haire, Hambright, Kidd, Los Gatos, Millsholm, and Sobrante series. Slope ranges from 2 to 50 percent. The underlying sandstone, shale, rhyolite, or basic igneous bedrock is at a depth of 10 to 60 inches or more. The surface layer is loam, very stony loam, silt loam, silty clay loam, and clay. Some areas have many rock outcrops.

Available water capacity is 1 to 10 inches. Reaction is very strongly acid to neutral. Permeability is moderately rapid to very slow in the subsoil.

These soils are suited to oak-grass range.

The major hazard on these soils is erosion.

Capability unit VIIe–1 (5)

This unit consists of well drained soils of the Felton, Forward, and Kidd series. Slope ranges from 30 to 75 percent. The soils formed in material derived from shale, sandstone, and rhyolite. The fractured bedrock is at a depth of 12 to 40 inches. The surface layer is gravelly loam. Some areas have common rock outcrops.

Available water capacity is 1 to 8 inches. Reaction is strongly acid to neutral. Permeability is moderately slow or moderately rapid.

These soils are well suited to wood products, watershed, and wildlife habitat. The plant cover is generally redwood, Douglas-fir, ponderosa pine, and such hardwoods as tan oak, live oak, madrone, and other broadleaf trees.

The hazard of erosion is high or very high.

Capability unit VIIe–1 (15)

This unit consists of well drained to excessively drained soils of the Bressa, Dibble, Fagan, Felton, Guenoc, Kidd, Hambright. Henneke, Los Gatos, Lodo, Maymen, Millsholm, and Montara series. Slope ranges from 5 to 75 percent but is mainly 50 to 75 percent. These soils formed in material weathered from shale, sandstone, rhyolite, basic igneous rocks, and serpentine. The fractured bedrock is at a depth of 6 to 40 inches. The surface layer is loam, silt loam, silty clay loam, and clay loam and contains gravel and stones in some areas.

Available water capacity ranges from 1 to 8 inches. Reaction is strongly acid to mildly alkaline. Permeability is moderately rapid to slow.

The soils in this unit are generally well suited to oak-grass range and to watershed and wildlife habitat.

Capability unit VIIIw–1 (14, 15)

This unit consists of soils that, because of special problems, cannot be used for farming.

Bale complex, 0 to 2 percent slopes, seeped, is high in salt. The concentration of salts is toxic to plants.

Reyes silty clay loam, salt ponds, is covered by water and is used as evaporation basins for salt crystallization.

Riverwash is adjacent to or part of channel waterways that are intermittently dry. They are subject to frequent flooding and so cannot be used for any permanent practices.

Capability unit VIIIs–1 (15)

This unit consists primarily of Rock outcrop, either alone or in complex with Hambright or Kidd soils. These areas are dominated by rock outcrops and produce essentially no forage for livestock or wildlife.

The areas need to be protected from fire or anything else that would destroy the delicate balance between existing vegetation and the limited soil among the rock outcrops.

Estimated yields and management guides

The average yields per acre that can be expected of the principal crops under a defined management are shown in table 2. 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. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil.

The management practices and estimated yields are based on observations made by personnel of the Soil Conservation Service and the University of California Agricultural Extension Service and on the County Agricultural Commissioner's report for Napa County.

The estimated yields and suggested management are based on current technology and plant varieties. New developments in crop breeding, control of insects and diseases, irrigation methods, and other management practices will eventually make obsolete some of the practices suggested and yields predicted.

The estimates shown in table 2 are averages that can be expected over a period of years. In any given year, yields may be considerably higher or lower than the average. If little or no information was available on yields of a given crop on a particular soil, estimates were made by comparing this soil with similar soils for which yield information was available.

In the pages that follow, the general management needed for each crop designated in table 2 is described and the special management needed for this crop on several groups of soils that are suitable for this crop is given. The soils in any one group are similar in the special management they require for the specified crop. Each group ordinarily contains all of the soils of one or more capability units.

All requirements for plant nutrients are for the elemental form; for example, pounds per acre of the element phosphorus. The grass irrigation requirement is the total annual plant need per acre less the average effective precipitation. The irrigation requirement is calculated on the assumption that the irrigation system is 70 percent efficient. It is further assumed that the yields listed in table 2 were grown under the optimum

TABLE 2.—*Yields per acre of crops and pasture*

[Yields in columns N are for nonirrigated soils; those in columns I are for irrigated soils. All yields were estimated for a high level of management in 1974. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Wine grapes		Pears		Prunes		Walnuts		Pasture		Barley	
	N	I	N	I	N	I	N	I	N	I	N	I
	Ton	*Ton*	*Ton*	*Ton*	*Ton*	*Ton*	*Ton*	*Ton*	*AUM*[1]	*AUM*	*Bu*	*Bu*
Aiken:												
100	2.0				1.0		0.3		1.0	6	25	
101					0.5		0.3		1.0	6	25	
Bale:												
103	5.0		10.0		2.0		0.5		1.6	10	25	
104	6.0		10.0		3.0		0.7		2.0	12	30	
105	6.0		10.0		3.0		0.7		2.0	12	30	
Bressa:												
[2]112:												
Bressa part									2.0	16		
Dibble part									2.0	16		
[2]113:												
Bressa part									1.6	12		
Dibble part									1.6	12		
[2]114:												
Bressa part									1.3			
Dibble part									1.3			
[2]115:												
Bressa part									1.0			
Dibble part									1.0			

See footnotes at end of table.

TABLE 2.—*Yields per acre of crops and pasture—Continued*

Soil name and map symbol	Wine grapes		Pears		Prunes		Walnuts		Pasture		Barley	
	N	I	N	I	N	I	N	I	N	I	N	I
	Ton	*Ton*	*Ton*	*Ton*	*Ton*	*Ton*	*Ton*	*Ton*	*AUM*[1]	*AUM*	*Bu*	*Bu*
Clear lake:												
116	2.0				2.0				3.3	12	50	
117	3.0				2.0				2.6	10	60	
Cole:												
118, 119	5.0		15.0		3.0		0.5		3.3	16	30	
Contra Costa:												
120, 121									3.3	16		
Coombs:												
122, 123	4.0		10.0		2.5		0.3		2.0	13	25	
Cortina:												
124, 125	3.0				3.0				2.0	13	25	
Diablo:												
126, 127, 128									3.3	16	50	
129									2.6	16	40	
Egbert:												
130									2.0	16	60	
Fagan:												
131, 132									3.3	16		
133									3.3			
134									2.6			
Guenoc:												
142									2.0			
[2]143, [2]144:												
Guenoc part									1.6			
Rock outcrop part												
Haire:												
145, 147	2.5		8.0		1.5				2.3	12	60	
146	2.0		6.0		1.0				2.0	10	50	
148	2.5		7.0		1.5				2.0	10	50	
149			5.0		0.5				1.6	10	40	
150									1.6	10	40	
Hambright:												
[2]151, [2]152:												
Hambright part									0.6			
Rock outcrop part												
Lodo:												
[2]157:												
Lodo part									1.0			
Maymen part									1.0			
Felton part									0.6			
Maxwell:												
161									0.3	4		
Maymen:												
[2]162:												
Maymen part									0.6			
Los Gatos part									0.6			
Millsholm:												
164									1.6	12		
165									1.3	10		
Montara:												
166, 167									1.3			
Perkins:												
168	4.0		10.0		2.5		0.3		2.0	13	25	
169	3.0		10.0		2.0		0.3		2.0	13	25	
Pleasanton:												
170, 171	6.0		20.0		3.0		0.8		3.3	14	50	
Reyes:												
172									1.6			
Sobrante:												
178				400					2.0	16		
179									1.6	12		
Tehama:												
180	4.0		10.0		2.0		0.5		1.6	12	25	
Yolo:												
181, 182	6.0		25.0		3.5		1.0		3.3	14	50	

[1] Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

[2] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

level of management. The optimum or best level of management known is the level of management that, according to experience, field trials, and research findings, would give the highest possible returns at this time and is within the capabilities of most farmers and ranchers in the county.

Grapes

Wine grapes are especially well suited to Napa Valley and adjacent areas.

Practices used in growing wine grapes include suckering, pruning, turning winter cover crops under by disking, and controlling weeds by springtooth and drag harrowing. Nematodes are controlled by fumigating the soil before planting. Sprinkler irrigation is used for planting, for protection against frost, and for heat suppression. There is little or no response to fertilizer. Dusting with sulfur controls mildew. Specific factors important in managing groups of soils for wine grapes follow.

Group 1. Soils of capabilty unit I (14) are in this group. Irrigation water is applied by sprinkler early in summer at the rate of 0.5 foot per acre.

Group 2. Soils of capability units IIe–1 (14) and IIIe–1 (14) are in this group. All tillage is done across the slope. Irrigation water is applied by sprinkler early in summer at the rate of 0.6 foot per acre.

Group 3. Soils of capability units IIe–3 (14), IIs–5 (14), IIIs–3 (14), and IIIe–3 (14) are in this group. All tillage is done across the slope. Irrigation water is applied by sprinkler early in summer at the rate of 0.4 foot per acre.

Group 4. Soils of capability unit IVs–4 (14) are in this group. Irrigation water is applied by sprinkler two or three times early in summer at the rate of 0.25 foot per acre per application.

Group 5. Soils of capability units IIw–2 (14) and IIIw–5 (14) are in this group. Tile drains or open ditches are used to keep the water table below the root zone. Irrigation water is applied early in summer at a rate of about 0.6 foot per acre on loams and 0.3 foot per acre on clays.

Group 6. All other soils in the county are not used for wine grapes, because they are not suitable or because no water is available for irrigation.

Pears

Pears are grown mainly around Carneros. They are also grown in Pope Valley and around Yountville.

Practices used in growing pears include pruning, disking cover crops, and thinning. To prevent compaction and damage to soil structure, soils should not be tilled when wet. Generally, the trees respond to nitrogen applied each year at a rate of ¾ to 1½ pounds per mature tree. Irrigation requirements vary by location and soil. Water content should be measured by auger or tube. The soils are irrigated by furrows or sprinklers. Specific factors important in managing groups of soils for pears follow.

Group 1. Soils of capability units I (14) and IIe–1 (14) are in this group. Both furrows and sprinklers are used. Sprinklers are more suitable for soils that have slopes of more than 2 percent. Water is applied at a rate of 0.6 foot per acre.

Group 2. Soils of capability unit IIw–2 (14) are in this group. Tile drains and open ditches are used to keep the water table below the root zone. Water is applied at the rate of 0.3 foot per acre.

Group 3. Soils of capability units IIe–3 (14), IIIe–1 (14), IIIs–3 (14), and IIIe–3 (14) are in this group. Soils that have slopes of less than 2 percent are irrigated by furrows or sprinklers. Soils that have slopes of 2 to 9 percent are irrigated by sprinklers. Water is applied at the rate of 0.4 foot per acre.

Group 4. All other soils in the county are not suited to or are not used for pears.

Prunes

Prunes are climatically suited to Napa Valley. Napa Valley prunes are high in quality. They are harvested by hand and by mechanical shaking. Irrigation is applied to young plantings and, where sufficient water is available, to mature plantings.

Practices used in growing prunes include pruning and disking and harrowing to work cover crops and manure into the soil, to prepare a seedbed for cover crops, and to aid penetration of water where the soil has been packed. Cultivation is shallow to avoid injuring roots. Mature prune trees require 60 to 100 pounds of nitrogen per acre. Zinc deficiency is corrected by spraying with zinc sulfate or zinc oxide early in spring. Boron deficiency is corrected by applying boron fertilizer on the surface every 3 to 5 years at the rate of 5.7 pounds of boron per acre. Specific factors important in managing groups of soils for prunes follow.

Group 1. Soils of capability unit I (14) and IIe–1 (14) are in this group. When they are irrigated, the soils that have slopes of less than 2 percent are irrigated by furrows. The soils that have slopes of more than 2 percent are irrigated by sprinklers. The soils require 0.6 to 0.7 foot of water per acre per application. Peak water use is in June, July, or August.

Group 2. Soils of capability units IIe–3 (14), IIs–5 (14), IIIe–3 (14), and IIIs–3 (14) are in this group. The soils that have slopes of less than 2 percent are irrigated by furrows or sprinklers. Soils that have slopes of 2 to 9 percent are irrigated by sprinklers. Water is applied at the rate of 0.4 foot per acre per application. Peak water use is in June, July, or August.

Group 3. Soils of capability unit IVs–4 (14) are in this group. The soils that have slopes of less than 2 percent are irrigated by furrows, and the soils that have slopes of 2 to 5 percent are irrigated by sprinklers. Frequent applications of water are needed to keep the root zone thoroughly moist during June, July, and August.

Group 4. Soils of capability units IIw–2 (14) and IIIw–5 (14) are in this group. Tile drains or open ditches are used to keep the water table below the root zone. Water is applied in June, July and August at a rate of 0.7 foot per acre.

Group 5. All other soils in the county are not suited to or are not used for prunes.

Walnuts

Walnuts are grown in Napa Valley and in secondary valleys in the county. Pests and disease have limited production in recent years.

Practices used in growing walnuts include plowing and disking cover crops and pruning and thinning the orchards. Applying 100 to 150 pounds of nitrogen per year, depending on soil fertility and the age of the orchard, increases the cover crop and increases production of nuts. Irrigation requirements vary according to the amount of precipitation in fall and winter. Low precipitation following fertilization in December or January necessitates irrigating before the trees start to grow in spring. Specific factors important in managing groups of soils for walnuts follow.

Group 1. Soils of capability units I (14) and IIe–1 (14) are in this group. Soils that have slopes of less than 2 percent are irrigated by sprinklers and furrows. Soils that have slopes of 2 to 5 percent are irrigated only by sprinklers. Water is applied as needed at the rate of 0.3 foot per acre per application.

Group 2. Soils of capability unit IIw–2 (14) are in this group. Tile drains or open ditches are used to keep the water table below the root zone. The soils should be sampled to determine the amount of preharvest irrigation needed and to prevent moisture stress and poor hull quality.

Group 3. Soils of capability units IIe–3 (14), IIIs–3 (14), and IIIe–3 (14) are in this group. Soils that have slopes of less than 2 percent are irrigated by furrows and sprinklers, and soils that have slopes of more than 2 percent are irrigated by sprinklers exclusively. Water is applied at an average rate of 0.4 foot per acre.

Group 4. All other soils in the country are not suited to or are not used for walnuts.

Irrigated pasture

Irrigated pasture is grown in many areas of Napa Valley.

After 4 or 5 years, irrigated pasture becomes weedy and difficult to irrigate. Forage production can be continued with crops such as oats and vetch for winter feed and sudangrass for summer pasture or hay. Crop rotation permits regrading and deep tillage, such as chiseling or subsoiling, to help to open up the soil for more efficient use of irrigation water, better control of weeds, and elimination of mosquito-producing areas. New planting also permits use of improved varieties or strains. Grazing rotation is determined by the legume-grass ratio and the pasture's rate of recovery. An average of 20 to 30 days between grazings is generally satisfactory. The soils generally need 40 pounds of phosphorus per acre per year in a single application and 120 to 150 pounds of nitrogen per acre per year in four or five equal applications after each grazing period just before irrigation. The soils are not grazed when wet. Each pasture is divided into three or more fields by fences. Management customarily includes preparing the seedbed by disking, chiseling, leveling, springtooth harrowing, bordering, harrowing, and cultipacking. Specific factors important in managing groups of soils for irrigated pasture follow.

Group 1. Soils of capability unit I (14), IIe–1 (14), IIe–5 (14), IIe–3 (14), and IIs–5 (14) are in this group. A typical seeding mixture is 2 pounds of ladino clover or 3 pounds of narrowleaf trefoil and 8 pounds of Goars tall fescue per acre. The soils are irrigated by borders or sprinklers. About 0.5 foot of water per acre is applied every 10 to 12 days during the season of peak use.

Group 2. Soils of capability units IIw–2 (14), IIIe–3 (14), IIIe–5 (5), IIIs–3 (14), and IVe–1 (14) are in this group. A typical seeding mixture is 2 pounds of ladino clover or 3 pounds of narrowleaf trefoil and 8 pounds of Goars tall fescue per acre. Water is applied at a rate of 0.5 to 0.6 foot per acre every 10 days during the season of peak use.

Group 3. Soils of capability unit IVs–4 (14) are in this group. A typical seeding mixture is 3 pounds of narrowleaf trefoil and 8 pounds of Goars tall fescue per acre. The soils should be disked, leveled, springtooth harrowed, bordered, harrowed, cultipacked, and planted. Water is applied by sprinklers at the rate of 0.3 foot per acre every 6 to 8 days during the season of peak use.

Group 4. Soils of capability unit IVe–9 (15) are in this group. A typical seeding mixture is 5 pounds of narrowleaf trefoil and 10 pounds of Goars tall fescue per acre. The soils that have slopes of less than 5 percent are irrigated by borders, and the soils that have slopes of more than 5 percent are irrigated by sprinklers. Water is applied at the rate of 0.3 foot per acre every 8 to 10 days.

Group 5. All other soils in the county are not used for irrigated pasture because irrigation water is not available.

Dryland barley

The seedbed for dryland barley is prepared by disking and harrowing. After treatment with a fungicide the seed is planted at a rate of 80 to 100 pounds per acre. Clay soils are chiseled to a depth of 2 to 3 feet to improve penetration of roots and moisture. The soils are not worked when wet. Crop residue is returned to the soil. Herbicides are used to control weeds. Specific factors important in managing groups of soils for barley follow.

Group 1. Soils of capability units I (14) and IIs–5 (14) are in this group. These soils require only the management described above.

Group 2. Soils of capability units IIw–2 (14) and IIIw–5 (14) are in this group. Tile drains or ditches help to maintain the water table below the root zone. The drains were installed for other crops but can benefit barley.

Group 3. Soils of capability units IIe–1 (14), IIe–5 (15), IIIe–1 (15), IIIe–3 (14), IIIs–3 (14), IVe–1 (15), IVe–3 (15) and IVe–5 (15) are in this group. If feasible, the soils should be tilled across the slope or on the contour. On the steep soils, diversions that have adequate outlets help to dispose of excess runoff.

Group 4. All other soils in this county are not suited to or are not used for dryland barley.

Dryland pasture

Dryland pasture is grown throughout Napa County.

Practices used in growing dryland pasture include preparing the seedbed by plowing or disking, seed drilling, fertilizing, and clearing brush. If perennial pasture plants are grown, sudangrass can be used in preplanting to reduce weeds. The pasture needs 60 to 80 pounds of nitrogen and 35 to 45 pounds of phosphorous per year. Planting is done between October 1 and December 1. Choice of seeding mixture depends on soil fertility and depth. Fertile soils take 10 pounds of pelleted subclover, 2 pounds of perennial ryegrass, and 2 pounds of either hardinggrass or perlagrass per acre. On south- or west-facing slopes, soils 1 to 2 feet deep take 8 pounds of pelleted subclover, 2 pounds of rose clover, 2 pounds of perennial ryegrass, and 2 pounds of orchardgrass per acre. Soils less than 1 foot deep take 4 pounds of pelleted subclover and 2 pounds of Blando brome or annual ryegrass per acre.

In the first year, livestock should be allowed on the pasture only after the ground is dry and the grass is 4 to 6 inches high. The second period of grazing can begin when the grass is 6 to 8 inches high. When the grass has been grazed to a height of 2 inches, the cattle are removed from the pasture until late summer.

In the second year, grazing should be so regulated that the grass is kept between 3 and 8 inches in height. Heavy grazing in summer should not hurt the stand.

In the third and fourth years, the pasture should receive 80 pounds of phosphorus per acre.

All of the soils in Napa County require similar management for dryland pasture. The soils are not placed in management groups.

Range[2]

Napa County contains 311,195 acres of rangeland, which is 64 percent of the county. Land ownership is primarily non-Federal. Being part of the northern coast ranges, Napa County is dominated by irregular, knobby, landslide topography of the Franciscan Formation. Elevation ranges mainly from 50 to 3,500 feet. Occasional ridges are above 4,000 feet. Precipitation is controlled by moisture-bearing winds from the Pacific Ocean. Precipitation increases sharply from the coast inland and then rapidly diminishes. There is also an increase from south to north.

Range sites

A range site is a distinctive kind of rangeland that differs from other kinds of rangeland in its potential to produce native plants (*15*). It is an interpretation of the soil, and it is a product of all environmental factors. A range site is an ecological subdivision of the landscape for study, evaluation, and management. Range sites are the basis for mapping the landscape and inventorying the range.

The essence of a range resource inventory is comparison of the site's potential with the site's present condition for analysis for planning or other purposes. Under grazing or browsing, plant species increase or decrease in proportion to the whole plant community. The response of a species to grazing depends on the season of the year that the plant is being used, on the type of animal using the plant, and on the intensity of use. Range trend is a determination of whether range condition is improving or deteriorating. The more important characteristics of vegetation and soil that indicate trend in range condition include plant vigor, abundance of seedlings, changes in composition, presence of plant residue, and stability of the soil.

For example, the natural potential vegetation for a certain range site may be grass, oak, and scattered brush. However, due to some disturbance or mismanagement, the site converts to pure brush. Similarly, the potential may be a mixture of soft chess, wild oats, and forbs, but due to mismanagement it reverts to foxtail fescue and vinegarweed. For some soils, potential is thick stands of brush.

The natural potential vegetation may not be the most productive vegetation for forage for livestock or big game. Natural potential vegetation is not a realistic management objective for sites in which the vegetation consists of annuals. The potential vegetation for some sites is brush or timber. Wild oats and ripgut brome dominate the potential vegetation for other sites. Range conditions below the potential permit higher percentages of soft chess, clover, and filaree, which make better wildlife and livestock forage.

A range site can be in poor ecological condition and at the same time be in good hydrologic condition. This often happens in California-Mediterranean-type climates. Good hydrologic condition should always be a goal of sound range management.

Proper grazing use includes leaving adequate litter residue (*10*). Proper grazing use is essential on all sites for runoff and erosion control and for enhancement of wildlife habitat and recreation value.

Soils in Napa County have been grouped into nine range sites. These are described on the following pages. Production is expressed as a current year's growth in air-dry weight per acre.

Clayey range site

This site consists of well drained clays of the Diablo series. Depth to soft consolidated sandstone and shale is 40 to 60 or more inches. Slope is 5 to 50 percent. Elevation ranges from 50 to 1,500 feet. Annual precipitation is 25 to 30 inches. Permeability is slow. Available water capacity is 6 to 10 inches. There is a hazard of erosion if a good plant cover is not maintained.

The potential plant community is approximately 70 percent grasses and 30 percent forbs. The grasses include 25 percent soft chess, 15 percent wild oats, 10 percent ryegrass, 5 percent ripgut brome, 5 percent wild barley, 5 percent annual fescue, 5 percent red brome, and a trace of perennial grasses such as needlegrass, wildrye, bluegrass, and melic. The forbs include 10 percent burclover, 10 percent filaree, 5 percent annual clover, 3 percent wild carrot, and 2 percent annual lupine. There are usually no trees on this site.

[2] By JAMES E. PRESTON, range specialist, Soil Conservation Service.

The total annual production, air-dry weight, is 4,000 pounds per acre in favorable years and 2,000 pounds per acre in less favorable years.

Heavy grazing by livestock causes desirable forage plants such as soft chess and wild oats to decrease and less desirable species such as wild barley, annual fescue, red brome, wild carrot, nitgrass, medusahead, dogtailgrass, tarweed, fiddleneck, popcornflower, vinegarweed, turkey mullein, thistle, and mustard to increase.

The soils are well suited to seeding with perlagrass if an adequate seedbed can be prepared. They are also suited to seeding with improved annual grasses and legumes where seeding is needed. Forage plants on these soils respond well to nitrogen and sulfur fertilizer. Little brush has invaded this site. Where brush has invaded, clearing is feasible.

Deer graze grass and forbs heavily on this site from December to April where this site is adjacent to cover. Drinking water is needed during dry seasons.

Fine Loamy range site

This site consists of well drained clay loams, silty clay loams, silt loams, gravelly loams, and loams of the Fagan, Bressa, Dibble, and Contra Costa series. The subsoil is silty clay loam or clay. Depth to standstone and shale is 20 to 60 inches. Slope is 5 to 75 percent. Elevation ranges from 200 to 2,000 feet. Annual precipitation is 20 to 35 inches. Permeability is slow or moderately slow. Available water capacity is 4 to 10 inches. These soils are subject to landslipping if good plant cover is not maintained.

The natural plant community consists of approximately 60 percent grasses, 30 percent forbs, and scattered blue and live oak. The grasses include 20 percent soft chess, 10 percent wild oats, 5 percent stipa, 5 percent California brome, 5 percent blue wildrye, 5 percent ripgut brome, 5 percent red brome, 3 percent wild barley, and 2 percent squirreltail. The forbs include 15 percent burclover, 5 percent filaree, 3 percent annual clover, 2 percent annual lupine, 2 percent American vetch, and 3 percent brodiaea.

The total annual production, air-dry weight, is 3,200 pounds per acre in favorable years and 1,600 pounds per acre in less favorable years.

Heavy grazing by livestock causes desirable forage plants such as soft chess and wild oats to decrease and less desirable forage plants such as wild barley, annual fescue, red brome, wild carrot, nitgrass, medusahead, dogtailgrass, tarweed, fiddleneck, popcornflower, vinegarweed, turkey mullein, and mustard to increase.

Most of the soils in this site that have slopes of less than 50 percent can be seeded to adaptable grasses and legumes. Forage plants respond well to fertilizer that contains nitrogen, phosphorus, and sulfur. Proper grazing and proper planning are important.

Deer graze grass and forbs from December to April. The wild oats and oak trees make this site very suitable for turkey. This site is also suitable habitat for wild pig because of the presence of broadiaea and other bulb-producing plants and oak mast. Drinking water is needed during dry seasons.

Shallow Coarse Loamy range site

This site consists of well drained and somewhat excessively drained loams and gravelly loams of the Maymen, Millsholm, and Lodo series. Depth to sandstone and shale is 6 to 20 inches. Slope is 15 to 75 percent. Elevation ranges from 400 to 2,500 feet. Annual precipitation is 25 to 40 inches. Permeability is moderate or moderately slow. Available water capacity is 1 to 4 inches.

The potential plant community is about half shrubs and trees, about half grasses and forbs, and some remnant perennial plants. The shrubs and trees include 10 percent interior live oak, 5 percent digger pine, 5 percent scrub oak, 10 percent chamise, 7 percent whiteleaf manzanita, 3 percent toyon, 2 percent redberry, 3 percent mountainmahogany, and 5 percent buckbrush. The grasses and forbs include 10 percent soft chess, 5 percent wild oats, 5 percent ripgut brome, 5 percent filaree, 10 percent burclover, 5 percent annual clover, 5 percent Spanish clover, 2 percent annual lupine, 2 percent wild carrot, and 1 percent yarrow.

The total annual production of grasses and forbs is 2,400 pounds per acre in favorable years and 1,200 pounds per acre in less favorable years. The total annual production of shrubs is 2,000 pounds per acre in favorable years and 1,500 pounds per acre in less favorable years. The total amount of vegetation above ground, for consideration of fuel management and cover values, is estimated at 10 tons per acre.

Heavy grazing of the grasses and forbs by livestock causes such plants as soft chess, wild oats, and burclover to decrease and such plants as wild barley, annual fescue, red brome, wild carrot, nitgrass, dogtailgrass, tarweed, fiddleneck, popcornflower, and vinegarweed to increase.

The soils on this site are not suitable for seeding and fertilizing because of the shallow depth and low available water capacity. Proper grazing and proper planning are the most important considerations.

This range site is one of the most important deer habitats in the county because of the diversity of food and cover plants. From October to May deer use shrubs, trees, grasses, and forbs. This site is also suitable habitat for turkey if drinking water is available. This site is very suitable for wild pig because brodiaea and other bulb-producing plants and oak mast provide adequate food and cover. Because of the diversity of cover, this site is very suitable for quail.

This site can be improved for wildlife habitat by releasing understory vegetation and making forage shrubs more accessible. Growth of nutritious shrub sprouts should be encouraged, and drinking water is needed during dry seasons.

Very Shallow Rocky range site

This site consists of well drained very stony loams and loams of the Hambright and Kidd series. Depth to bedrock ranges from 10 to 20 inches. Rock outcrops are common. Slope ranges from 2 to 75 percent. Elevation ranges from 400 to 4,300 feet. Annual precipitation is 23 to 60 inches. Permeability is moderate. Available water capacity is 1 to 3 inches.

The natural potential plant community is approximately 75 percent shrubs and trees and 25 percent grasses and forbs. The trees and shrubs include 20 percent whiteleaf manzanita, 10 percent chamise, 10 percent wavyleaf ceanothus, 5 percent Sonoma ceanothus, 15 percent toyon, 2 percent yerba-santa, 10 percent scrub oak, and 3 percent California laurel. Blue oak, digger pine, and live oak form a 20 percent crown cover. The grasses and forbs include 10 percent soft chess, 5 percent filaree, 6 percent annual clover, 2 percent annual lupine, and 2 percent wild carrot.

The total annual production of grass and forbs, air-dry weight, is 1,600 pounds per acre in favorable years and 600 pounds per acre in less favorable years. The total annual production of shrubs and trees, air-dry weight, is 5,000 pounds per acre in favorable years and 3,500 pounds per acre in less favorable years. The total amount of vegetation above ground, for consideration of fuel management and cover values, is estimated at 20 or more tons per acre.

If brush is chained, shredded, burned, or manipulated in some way to prevent the excessive accumulation of old growth, browse forage can become unavailable to livestock and wildlife. Many thousand acres of this range site is inaccessible for grazing.

Brush management, proper grazing, and proper planning are important. The soils on this site are not suitable for seeding and fertilizing because of the shallow depth and low available water capacity.

This site is only fair habitat for deer because of the small amount of open area. From October to May, deer use shrubs, trees, grasses, and forbs. This site is poor habitat for turkey because of the lack of open areas. This site is very suitable for wild pig because brodiaea and other bulb-producing plants and oak mast provide adequate food and cover. This site is very good habitat for quail and fair habitat for band-tailed pigeon.

Establishing browseways or lanes from clearings improves access to and use by wildlife. Small clearings are less likely to cause excessive erosion than large clearings, and deer are better able to use the increased food produced. In large cleared areas, deer population generally does not grow rapidly enough to make full use of the new food supply. Drinking water is needed during dry seasons.

Loamy Upland range site

This site consists of well drained loams of the Sobrante, Guenoc, and Los Gatos series. Depth to sandstone and basic igneous bedrock ranges from 22 to 40 inches. Slope ranges from 5 to 75 percent. Elevation ranges from 400 to 3,000 feet. Annual precipitation is 25 to 40 inches. Permeability is moderate or moderately slow. Available water capacity is 3 to 8 inches.

The natural potential plant community is approximately 75 percent grasses and forbs and as much as 25 percent shrubs and trees. The grasses and forbs include 15 percent soft chess, 5 percent wild oats, 5 percent stipa, 5 percent California brome, 5 percent blue wildrye, 10 percent burclover, 10 percent filaree, 5 percent annual clover, 5 percent Spanish clover, 2 percent annual lupine, 2 percent buttercups, 2 percent primrose, 2 percent blue-eyed-grass, and 1 percent brodiaea. The shrubs and trees include manzanita, ceanothus, toyon, California laurel, and black oak.

The total annual production of grasses and forbs, air-dry weight, is 2,000 pounds per acre in favorable years and 800 pounds per acre in less favorable years. The total annual production of shrubs and trees, air-dry weight, is 800 pounds per acre in favorable years and 600 pounds per acre in less favorable years.

Heavy grazing by livestock causes desirable forage plants such as soft chess and burclover to decrease and less desirable forage plants such as ripgut brome, red brome, annual fescue, wild barley, squirreltailgrass, dogtailgrass, nitgrass, silverhairgrass, tarweed, popcornflower, fiddleneck, turkey mullein, and thistle to increase.

The soils are well suited to seeding with improved annual forage plants if seeding is needed. The soils are also suited to seeding with perlagrass if an adequate seedbed can be prepared. Forage plants respond well to fertilizer. Clearing is feasible where brush has invaded.

This site is good habitat for deer, which use grasses and forbs heavily from December to April. Habitat for quail is excellent. Habitat for turkey is good, since wild oats and oak mast provide adequate food and cover. This site is fair habitat for band-tailed pigeon. This site is fair habitat for wild pig. Brodiaea and other bulb-producing plants and oak mast provide food for pigs. Drinking water is needed during dry seasons.

Shallow Fine Loamy range site

This site consists of well drained loams of the Millsholm series. Depth to sandstone ranges from 12 to 20 inches. Slope ranges from 15 to 75 percent. Elevation ranges from 500 to 2,500 feet. Annual precipitation is 25 to 35 inches. Permeability is moderate. Available water capacity is 2 to 4 inches.

The natural potential plant community is approximately 60 percent grasses and forbs and 40 percent shrubs and trees. The grasses and forbs include 20 percent soft chess, 10 percent remnant perennial grasses, 15 percent filaree, 5 percent annual clovers, 5 percent wild oats, 2 percent wild carrot, and 3 percent annual lupine. The shrubs and trees included 15 percent scattered oaks, 3 percent digger pine, 7 percent ceanothus, 3 percent toyon, 10 percent manzanita, and 2 percent California laurel.

The total annual production of grasses and forbs, air-dry weight, is 1,500 pounds per acre in favorable years and 800 pounds per acre in less favorable years. The total annual production of shrubs and trees, air-dry weight, is 1,200 pounds per acre in favorable years and 600 pounds per acre in less favorable years. Much of the herbage is not readily available for grazing. The total amount of vegetation above ground, for consideration of fuel management and cover values, is 5 or more tons per acre.

Heavy grazing of the grasses and forbs by livestock causes desirable forage species such as soft chess, wild oats, and burclover to decrease and less desirable forage species such as ripgut brome, wild barley, annual fescues, red brome, nitgrass, and dogtailgrass to increase.

The soils are not well suited to seeding, because of the shallow depth and low available water capacity. Reduction of brush is feasible where brush has invaded.

This site is one of the most important habitats for deer because of the diversity of food and cover plants. From October to May, deer use shrubs, trees, grasses, and forbs. This site is suitable for turkey. This site is very suitable for wild pig because broadiaea and other bulb-producing plants and oak mast provide adequate food and cover. This site is also very suitable for quail because of the diversity of cover plants.

This site can be improved for wildlife habitat by releasing understory vegetation and making forage shrubs more accessible. Growth of nutritious shrub sprouts should be encouraged. Drinking water is needed during dry seasons.

Rocky Serpentine range site

This site consists of excessively drained gravelly loams of the Henneke series. Depth to serpentine bedrock ranges from 10 to 20 inches. Slope ranges from 5 to 75 percent. Elevation ranges from 500 to 4,000 feet. Annual precipitation is 20 to 45 inches. Permeability is moderately slow. Available water capacity is 1 to 3 inches.

The natural potential plant community is 90 percent shrubs and trees, including 20 percent chamise, 5 percent buckbrush, 15 percent whiteleaf manzanita, 15 percent scrub oak, 5 percent yerba-santa, 5 percent toyon, 2 percent chaparralpea, 3 percent mountain-mahogany, 10 percent MacNab cypress, 2 percent digger pine, and 8 percent live oak and blue oak. Scattered grasses such as stipa, poa, soft chess, annual bromes and fescues and filaree, annual clovers, and various other forbs are present in places.

The total annual production of shrubs and trees, air-dry weight, is 1,000 pounds per acre in favorable years and 600 pounds per acre in less favorable years. Much of the herbage is inaccessible to grazing animals. The total amount of vegetation above ground, for consideration of fuel management and cover values, is estimated at 5 tons per acre.

In brushy fields, much of the forage and other vegetation is not available for food and cover.

Brush management and proper grazing use are effective on this site. The soils are not suitable for seeding, because of the slope and the narrow calcium-magnesium ratio.

The hydrologic condition on this site is generally poor.

This site is fair habitat for deer and quail and poor habitat for turkey, band-tailed pigeon, and wild pig.

Claypan range site

This site consists of moderately well drained clay loams and loams of the Haire series. Depth to the clay subsoil ranges from 15 to 30 inches. Slope ranges from 9 to 30 percent. Elevation ranges from 20 to 300 feet. Annual precipitation is 25 to 30 inches. Permeability is very slow. Available water capacity is 3 to 6 inches.

The natural potential plant community consists mainly of grasses and forbs. There are some scattered oak. The grasses and forbs include soft chess, wild oats, ryegrass, filaree, Spanish clover, annual clovers, wild carrots, annual lupine, small amounts of burclover, and remnant perennial grasses.

The total annual production, air-dry weight, is 3,000 pounds per acre in favorable years and 1,500 pounds per acre in less favorable years.

Heavy grazing by livestock causes the natural plant community to decrease and less desirable forge plants such as ripgut brome, red brome, wild barley, annual fescue, medusahead, dogtailgrass, silverhairgrass, nitgrass, plantain, thistle, fiddleneck, tarweed, popcornflower, and wild mustard to increase.

The soils are well suited to seeding with perlagrass if an adequate seedbed can be prepared. They also are well suited to seeding with improved annual grasses and legumes where seeding is needed. Forage plants respond well to fertilizer. Proper grazing is important for reduced sedimentation, potential forage production, and a generally enhanced environment.

Deer graze grass and forbs heavily from December to April. Drinking water is needed during dry seasons.

Serpentine range site

This site consists of well drained clays and clay loams of the Maxwell and Montara series. Some of the soils are artificially drained. Depth to serpentine ranges from 10 to 15 inches or is more than 60 inches. Slope ranges from 2 to 50 percent. Elevation ranges from 200 to 2,500 feet. Annual precipitation is 25 to 45 inches. Permeability is moderately slow or very slow. Available water capacity is 2 to 12 inches.

The natural potential plant community is about half grasses and forbs and about half shrubs and trees. The grasses and forbs included 20 percent soft chess, 10 percent remnant perennial grasses, 5 percent filagree, 5 percent annual clovers, 5 percent Spanish clover, 2 percent annual lupine, 3 percent wild carrot, 2 percent owl clover, and 2 percent brodiaea. The shrubs and trees include 20 percent chamise, 5 percent buckbrush, 2 percent yerba-santa, 10 percent whiteleaf manzanita, 5 percent toyon, and 8 percent digger pine, live oak, and blue oak.

The total annual production of grasses and forbs, air-dry weight, is 1,250 pounds per acre in favorable years and 500 pounds per acre in less favorable years. The total annual production of shrubs and trees, air-dry weight, is 1,250 pounds per acre in favorable years and 800 pounds per acre in less favorable years. Much of the herbage is inaccessible for grazing. The total amount of vegetation above ground, for consideration of fuel management and cover values, is estimated at 5 tons per acre.

Dense brush reduces access to forage. Heavy grazing by livestock causes the natural plant community to decrease and less desirable forage plants such as red brome, annual fescues, vinegarweed, nitgrass, and silverhairgrass to increase.

The soils are not suited to seeding because the dominant slope is 45 percent and the calcium-magnesium ratio is unfavorable.

This site is important habitat for deer because of the diversity of food and cover plants. From October to May, deer use shrubs, trees, grasses, and forbs. This site is suitable habitat for turkey. This site is very

suitable for wild pig because brodiaea and other bulb-producing plants and oak mast provide adequate food and cover. This site is very suitable for quail because of the diversity of cover plants.

This site can be improved for wildlife habitat by releasing understory vegetation and making forage shrubs more accessible. Growth of nutritious shrub sprouts should be encouraged. Drinking water is needed during dry seasons.

Woodland[3]

Napa County contains about 65,000 acres of woodland. Thirty-eight thousand acres is classified as commercial forest, and the remainder as noncommercial (*4*). This section contains information that will aid land managers in conserving this resource.

The importance of woodland in Napa County has changed over the past few decades. The use of woodland shifted from small timber harvesting operations and clearing for farmland to exploitation. This trend was stopped by the passage of a county ordinance in the early 1970's that placed a moratorium on logging in Napa County. This restriction was modified somewhat with the passage of the California Forest Practices Act and Rules in 1974. The trend now is to manage woodland more for recreation, wildlife habitat, and open space than strictly for fiber production.

The vegetation in the western part of the county is mostly of the redwood type (*12*). This cover type consists mainly of redwood and Douglas-fir and small amounts of madrone and California laurel.

[3] By GENE ANDERSON, woodland specialist, Soil Conservation Service.

Eastward, the county has a more complex mixture of species making up three different cover types: (1) red alder, (2) oak-madrone, and (3) ponderosa pine, Douglas-fir. Napa County is in a transitional zone for forest types, and many species not normally found together are closely associated in this area.

The red alder type is in moist bottom areas that are somewhat protected. The stands contain mostly red alder and in some places Oregon ash, black cottonwood, vine maple, bigleaf maple, cascara buckthorn, and western dogwood. Occasionally Douglas-fir or Sitka spruce grow as a minor species in this cover type—sometimes as suppressed individuals in the understory and sometimes as old growth remnants of a previous stand.

The oak-madrone type occurs on the drier sites. The soils generally are shallower and have lower water capacity than the soils in the other forest types. The oak-madrone type ocurs both as subclimax and as climax forest in Napa County. Tan oak, California live oak, or Pacific madrone is the main species. Canyon live oak, Oregon white oak, California black oak, California laurel, bigleaf maple, and other minor hardwoods also grow in the stands. The only common conifer is Douglas-fir.

Gradations of the ponderosa pine, Douglas-fir type grow in Napa County. Although ponderosa pine and Douglas-fir are dominant, neither makes up more than 80 percent of a stand. Many other conifers and hardwoods can also grow in the stands. This forest type grows on the best timber land on northern slopes. This type may be a transitional stage between a hardwood forest type and a coniferous forest type.

Table 3 contains information useful to woodland owners or forest managers planning use of soils for

TABLE 3.—*Woodland management and productivity*

[Only the soils suitable for production of commercial trees are listed in this table. Absence of an entry in a column means the information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index	
Aiken:								
100, 101	3o	Slight	Slight	Slight	Severe	Douglas-fir Ponderosa pine Redwood	140 148 ---	Douglas-fir, Monterey pine, Coulter pine, ponderosa pine.
102	3r	Moderate	Slight	Slight	Severe	Douglas-fir Ponderosa pine Redwood	140 148 ---	Douglas-fir, Monterey pine, Coulter pine, ponderosa pine.
Boomer:								
107, 108	3o	Slight	Slight	Slight	Severe	Ponderosa pine Douglas-fir	130 130	Ponderosa pine, Monterey pine, Coulter pine, Douglas-fir.
109	3r	Moderate	Slight	Slight	Severe	Ponderosa pine Douglas-fir	130 130	Ponderosa pine, Monterey pine, Coulter pine, Douglas-fir.

See footnote at end of table.

TABLE 3.—*Woodland management and productivity—Continued*

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Important trees	Site index	
[1]110:								
Boomer part	3o	Slight	Slight	Slight	Severe	Ponderosa pine	130	Ponderosa pine, Monterey pine, Coulter pine, Douglas-fir.
						Douglas-fir	130	
Forward part	3o	Slight	Slight	Slight	Severe	Douglas-fir	140	Ponderosa pine, Douglas-fir, Monterey pine, Coulter pine.
						Ponderosa pine		
						Redwood		
Felta part.								
[1]111:								
Boomer part	3r	Moderate	Slight	Slight	Severe	Ponderosa pine	130	Ponderosa pine, Monterey pine, Coulter pine, Douglas-fir.
						Douglas-fir	130	
Forward part	4r	Severe	Slight	Slight	Severe	Douglas-fir	110	Ponderosa pine, Douglas-fir, Monterey pine, Coulter pine.
						Ponderosa pine		
						Redwood		
Felta part.								
Felton:								
135	3o	Slight	Slight	Slight	Severe	Douglas-fir	140	Douglas-fir, Monterey pine, Coulter pine, ponderosa pine.
136	3r	Moderate	Slight	Slight	Severe	Douglas-fir	140	Douglas-fir, Monterey pine, Coulter pine, ponderosa pine.
137	3r	Severe	Moderate	Slight	Severe	Douglas-fir	140	Douglas-fir, Monterey pine, Coulter pine, ponderosa pine.
Forward:								
138, 139	4o	Slight	Slight	Slight	Severe	Douglas-fir	110	Ponderosa pine, Douglas-fir, Monterey pine, Coulter pine.
						Ponderosa pine	120	
						Redwood		
140	4r	Severe	Slight	Slight	Severe	Douglas-fir	110	Ponderosa pine, Douglas-fir, Monterey pine, Coulter pine.
						Ponderosa pine	120	
						Redwood		
[1]141:								
Forward part	4r	Severe	Slight	Slight	Severe	Douglas-fir	110	Ponderosa pine, Douglas-fir, Monterey pine, Coulter pine.
						Pondersoa pine	120	
						Redwood		
Kidd part.								
Lodo:								
[1]157:								
Lodo part						Live oak		
						Digger pine		
Maymen part.								
Felton part	3r	Severe	Moderate	Slight	Severe	Douglas-fir	140	Douglas-fir, Monterey pine, Coulter pine, ponderosa pine.
Maymen:								
[1]163:								
Maymen part.								
Millsholm part.								
Lodo part						Live oak		
						Digger pine		

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

wood crops. Mapping unit symbols for soils suitable for wood crops are listed, and the ordination symbol for the woodland suitability groups of each soil is given. All soils in a woodland suitability group require the same general kinds of woodland management and have about the same potential productivity (*9*).

The first part of the *ordination symbol* for the group, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *r* indicates steep slopes, and the letter *o* indicates insignificant limitations or restrictions.

In table 3 the soils are also rated for a number of factors to be considered in management. *Slight, moderate,* and *severe* are used to indicate the degree of major soil limitations.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or equipment; *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree that the soil affects expected mortality of planted tree seedlings when plant competition is not a limiting factor. Seedlings from good planting stock that are properly planted during a period of sufficient rainfall are rated. A rating of *slight* indicates that the expected mortality of the planted seedlings is less than 25 percent; *moderate,* 25 to 50 percent; and *severe,* more than 50 percent.

Considered in the ratings of *windthrow hazard* are characteristics of the soil that affect the development of tree roots and the ability of soil to hold trees firmly. A rating of *slight* indicates that trees in wooded areas are not expected to be blown down by commonly occurring winds; *moderate,* that some trees are blown down during periods of excessive soil wetness and strong winds; and *severe,* that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade or grow if openings are made in the tree canopy. The invading plants compete with native plants or planted seedlings by impeding or preventing their growth. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* means that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed for the control of undesirable plants.

The *potential productivity* of merchantable or *important trees* on a soil is expressed as a *site index.* This index is the average height in feet that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Important trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suitable for commercial wood production and that are suited to the soils.

The woodland suitability groups in Napa County are described on the following pages.

Woodland suitability group 3o

This group consists of well drained, deep and very deep loams and clay loams of the Aiken, Boomer, Felton, and Forward series. Some of the soils are gravelly. Slope ranges from 2 to 30 percent. Elevation ranges from 300 to 2,500 feet. Mean annual precipitation is 30 to 50 inches, and the frost-free season is 200 to 260 days. Permeability and runoff are moderate.

All of the soils are in site class 3 for Douglas-fir. The Aiken and Boomer soils are in site class 1 for ponderosa pine.

Equipment limitations are slight. Trafficability is good except when the soil is wet. There are few limitations for operation of any kind of vehicle. If a seed source is near, seedlings establish easily after logging. Site preparation is needed in places, and ponderosa pine must be planted in some places. Windthrow hazard is slight. Plant competition is severe. Some unstocked, cutover areas require special practices to reduce competition from grass and brush.

The soils are suited to intensive management. Trees grow rapidly and respond to early pruning and thinning. Roads and landings need water bars and grass seeding to prevent erosion.

These soils are well suited to Christmas trees.

Woodland suitability group 3r

This group consists of well drained, deep and very deep loams and clay loams of the Aiken, Broomer, and Felton series. Some of the soils are gravelly. Slope ranges from 30 to 50 percent. Elevation ranges from 300 to 2,500 feet. Mean annual precipitation is 30 to 50 inches, and the frost-free season is 200 to 260 days. Permeability is moderate. Runoff is rapid.

All of the soils are in site class 3 for Douglas-fir. Site index is 130 to 140. The Boomer gravelly loam and the Aiken soil are in site class 1 for ponderosa pine, with a site index of 130 to 145.

The soils produce good stands of Douglas-fir and ponderosa pine. Redwood is mixed with fir on the more moist sites.

Equipment limitations are moderate. Trafficability is restricted by steep slopes and during wet periods. Excessive soil disturbance by tractor logging can be a problem. Seedling mortality is slight. The soils have good moisture capacity and are in a favorable climatic zone. Natural regeneration is generally good but in places needs to be supplemented by preparing the site and by planting, especially for ponderosa pine. Weeding and thinning are needed for good stand development. The windthrow hazard is slight. Plant competition is severe. Some unstocked, cutover areas require

special practices to reduce competition from grass and brush.

Soils in this group are suited to intensive management. Roads, skid trails, and landings need water bars and grass seeding in places to prevent erosion. Temporary and minor roads should be outsloped. Where roads cross creeks, the grade should slope downward towards the watercourse on each side.

These soils are not well suited to production of Christmas trees, because the steep slopes cause difficulty in management and harvesting.

Woodland suitability group 4o

This group consists of well drained, deep gravelly loams and loams of the Forward series. Slope ranges from 2 to 30 percent. Elevation ranges from 400 to 3,500 feet. Mean annual precipitation is 30 to 55 inches, and the frost-free season is 200 to 260 days. Permeability and runoff are moderate.

All of the soils are in cite class 4 for Douglas-fir. The site index is 110. For ponderosa pine the soils are in class 1. The average site index for ponderosa pine is 113 on the Forward gravelly loam and 120 on the Forward loam.

Equipment limitations are moderate. Trafficability is limited when the soil is wet. Seedling mortality is slight. The soils have fair moisture capacity and are in a favorable climatic zone. Natural regeneration is generally good, but in places site preparation and planting are needed, especially for ponderosa pine. Weeding and thinning are needed for good stand development. Windthrow hazard is slight. Plant competition is severe. Some unstocked, cutover areas require special practices to reduce competition from grass and brush.

The soils are suited to forest management. Roads, skid trails, and landings need water bars and grass seeding in places to prevent erosion. Temporary and minor roads should be outsloped.

These soils are suited to Christmas trees.

Woodland suitability group 4r

This unit consists of well drained, deep gravelly loams and loams of the Forward series. Slope ranges from 30 to 75 percent. Elevation ranges from 400 to 3,500 feet. Mean annual precipitation is 30 to 35 inches, and the frost-free season is 200 to 260 days. Permeability is moderate, and runoff is rapid.

All of the soils are in site class 4 for Douglas-fir, with a site index of 110. For pondersoa pine, the soils are in site class 1. The site index for ponderosa pine is 113 on the Forward gravelly loams and 120 on the Forward loams.

Equipment limitations are generally moderate. On Forward gravely loam, 50 to 75 percent slopes, equipment limitations are severe. Trafficability is limited when the soil is wet. Seedling mortality is slight. The soils have fair moisture capacity and are in a favorable climatic zone. Natural regeneration is generally good, but site preparation and planting are necessary in places, especially for ponderosa pine. Weeding and thinning are needed for a good stand. Windthrow hazard is slight.

The soils are suited to forest crops, but the steep slopes and lower productivity limit possible management. Roads, skid trails, and landings need water bars and grass seeding in places to prevent erosion. Temporary and minor roads should be outsloped. Where slopes are more than 50 percent, roads and skid trails must be carefully positioned to prevent erosion.

These soils are not suited to Christmas trees because of the steep slopes.

Wildlife[4]

Fish and wildlife provide opportunities for recreation in Napa County. The wide diversity of vegetation, topography, and land-use patterns in the county provides many types of habitat that are well suited to a variety of both game and nongame wildlife. Stands of vegetation on the banks of numerous streams and creeks provide food and cover for many species of fish and wildlife. The major species of wildlife in the area include blue grouse, the migratory band-tailed pigeon, and feral pigs. The major species of cold-water fish are steelhead and salmon, which spend part of their life cycle in the Napa River and its tributaries, and trout which inhabit streams and larger lakes. Warm water species such as black bass, crappie, catfish, and sunfish inhabit numerous farm ponds and larger lakes such as Lake Berryessa and Lake Hennessy.

Many wildlife species such as upland game birds and songbirds require access to more than one habitat type. For example, valley quail require a mixture of vegetation such as that produced where areas of trees and shrubs border open areas of herbaceous plants such as clovers and grasses. Most types of wildlife are suited to areas that have the characteristics of two or more different types of habitat.

The suitability of different areas for use as wildlife habitat and the management practices used in these areas are discussed in the section "Range".

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, inadequate, or inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 4, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element

[4] By DAVE PATTERSON, biologist, Soil Conservation Service.

of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be exposed. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

Grain and seed crops are seed-producing annuals used by wildlife. Examples are corn, wheat, oats, and barley. The major soil properties 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.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Examples are fescue, lovegrass, bromegrass, clover, and alfalfa. Major soil properties 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.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, goldenrod, beggarweed, wheatgrass, and grama. Major soil properties 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.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foilage that wildlife et. Examples of native plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated good are Russian-olive, autumn-olive, and crabapple. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Examples are pine, spruce, fir, cedar, and juniper. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foilage used by wildlife or that provide cover and shade for some species of wildlife. Examples are mountainmahogany, bitterbrush, snowberry, and big sagebrush. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, and cordgrass and rushes, sedges, and reeds. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control devices in marshes or streams. Examples are marshes, waterfowl feeding areas, and ponds. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, vineyards, orchards, 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 kinds of wildlife attracted to these areas include mountain and valley quail, pheasant, meadowlark, racoon, mourning dove, field sparrow, cottontail rabbit, fox, and a few band-tailed pigeons.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, mountain and valley quail, squirrels, mountain lion, grey fox, raccoon, deer, bear and a few feral pigs.

Wetland habitat consists of open, marshy or swampy, shallow-water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shorebirds, muskrat, mink, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include coyote, white-tailed deer, desert mule deer, a few feral pigs, sage grouse, meadowlark, valley and mountain quail, and lark bunting.

Recreation

The soils of the survey area are rated in table 5 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are

TABLE 4.—*Wildlife*

[See text for definitions of "good," "fair," "poor," and "very

Soil name and map symbol	Potential for habitat elements					
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs
Aiken:						
100	Fair	Good	Good	Good	Good	Good
101	Poor	Fair	Good	Good	Good	Good
102	Very poor	Poor	Good	Good	Good	Good
Bale:						
103, 104, 105	Good	Good	Good			Good
[1] 106:						
Bale loam part	Very poor	Very poor	Poor			Poor
Bale clay loam part	Very poor	Very poor	Poor			Poor
Boomer:						
107, 108	Poor	Fair	Fair	Good	Good	Fair
109	Very poor	Poor	Fair	Good	Good	Fair
[1] 110:						
Boomer part	Poor	Fair	Fair	Good	Good	Fair
Forward part	Poor	Fair	Fair	Good	Good	Good
Felta part	Poor	Fair	Fair			Fair
[1] 111:						
Boomer part	Very poor	Poor	Fair	Good	Good	Fair
Forward part	Very poor	Poor	Fair	Good	Good	Good
Felta part	Very poor	Poor	Fair			Fair
Bressa:						
[1] 112:						
Bressa part	Fair	Good	Good			Good
Dibble part	Fair	Good	Good			Good
[1] 113, [1] 114:						
Bressa part	Poor	Fair	Good			Good
Dibble part	Poor	Fair	Good			Good
[1] 115:						
Bressa part	Very poor	Very poor	Fair			Fair
Dibble part	Very poor	Very poor	Good			Good
Clear Lake:						
116	Good	Good	Poor			Poor
117	Fair	Good	Poor			Very poor
Cole:						
118	Good	Good	Good			Good
119	Good	Good	Good			Good
Contra Costa:						
120, 121	Poor	Fair	Fair			Fair
Coombs						
122	Good	Good	Good			Good
123	Fair	Good	Good			Good
Cortina:						
124	Fair	Fair	Fair			Fair
125	Very poor	Very poor	Fair			Fair
Diablo:						
126, 127	Fair	Good	Fair			Poor
128	Fair	Fair	Fair			Poor
129	Poor	Fair	Poor			Poor
Egbert:						
130	Poor	Fair	Good			Good
Fagan:						
131	Fair	Good	Good			Good
132	Poor	Fair	Good			Good
133	Very poor	Very poor	Good			Fair
134	Very poor	Very poor	Fair			Fair
Felton:						
135	Poor	Fair	Good	Fair	Good	Good
136	Very poor	Poor	Good	Fair	Good	Good
137	Very poor	Very poor	Fair	Fair	Good	Fair
Forward:						
138	Fair	Good	Fair	Good	Good	Good
139	Poor	Fair	Fair	Good	Good	Good
140	Very poor	Very poor	Fair	Good	Good	Good
[1] 141:						
Forward part	Very poor	Very poor	Fair	Good	Good	Good
Kidd part	Very poor	Very poor	Poor			Fair

See footnote at end of table.

habitat potentials

poor." Absence of an entry indicates the soil was not rated]

Potential for habitat elements—Continued		Potential as habitat for—			
Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Very poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Poor	Good	Very poor	
Good	Fair	Good		Fair	Good.
Fair	Fair	Good		Fair	Poor.
Fair	Fair	Good		Fair	Poor.
Very poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Poor	Good	Very poor	
Very poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Fair	Good	Very poor	
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor	Good	Very poor	
Very poor	Very poor	Poor	Good	Very poor	
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Good		Very poor	Good.
Very poor	Very poor	Good		Very poor	Good.
Very poor	Very poor	Fair		Very poor	Good.
Very poor	Very poor	Fair		Very poor	Good.
Very poor	Very poor	Very poor		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Good.
Poor	Fair	Good		Poor	Poor.
Very poor	Good	Fair		Fair	Poor.
Good	Good	Good		Good	Good.
Fair	Poor	Good		Fair	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Poor	Very poor	Good		Very poor	Good.
Poor	Very poor	Good		Very poor	Good.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Very poor		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Poor.
Very poor	Very poor	Fair		Very poor	Poor.
Very poor	Very poor	Poor		Very poor	Poor.
Good	Good	Fair		Good	Good.
Very poor	Very poor	Good		Very poor	Good.
Very poor	Very poor	Fair	Good	Very poor	Good.
Very poor	Very poor	Very poor	Fair	Very poor	Fair.
Very poor	Very poor	Very poor	Fair	Very poor	Fair.
Very poor	Very poor	Fair	Fair	Very poor	
Very poor	Very poor	Poor	Fair	Very poor	
Very poor	Very poor	Poor	Fair	Very poor	
Very poor	Very poor	Fair	Fair	Very poor	
Very poor	Very poor	Fair	Fair	Very poor	
Very poor	Very poor	Poor	Fair	Very poor	
Very poor	Very poor	Poor	Fair	Very poor	Fair.
Very poor	Very poor	Very poor		Very poor	Poor.

TABLE 4.—*Wildlife*

Soil name and map symbol	Potential for habitat elements					
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs
Guenoc:						
142	Very poor	Poor	Fair			Good
[1] 143:						
Guenoc part	Very poor	Poor	Fair			Good
Rock outcrop part.						
[1] 144:						
Guenoc part	Very poor	Very poor	Fair			Good
Rock outcrop part.						
Haire:						
145, 147	Fair	Good	Good			Fair
146, 148	Fair	Good	Good			Fair
149	Fair	Fair	Good			Fair
150	Poor	Fair	Good			Fair
Hambright:						
[1] 151:						
Hambright part	Poor	Fair	Fair			Fair
Rock outcrop part.						
[1] 152:						
Hambright part	Very poor	Very poor	Fair			Fair
Rock outcrop part.						
Henneke:						
153, 154	Very poor	Very poor	Poor			Poor
Kidd:						
155	Poor	Fair	Poor			Fair
156	Very poor	Very poor	Poor			Fair
Lodo:						
[1] 157:						
Lodo part	Very poor	Very poor	Poor	Poor	Poor	Poor
Maymen part	Very poor	Very poor	Poor			Good
Felton part	Very poor	Very poor	Fair	Fair	Good	Fair
Los Gatos:						
158	Poor	Fair	Good			Good
159	Poor	Fair	Good			Good
160	Very poor	Very poor	Good			Good
Maxwell:						
161	Poor	Fair	Fair			Fair
Maymen:						
[1] 162:						
Maymen part	Very poor	Very poor	Poor			Good
Los Gatos part	Very poor	Very poor	Good			Good
[1] 163:						
Maymen part	Very poor	Very poor	Poor			Good
Millsholm part	Very poor	Very poor	Poor			Poor
Lodo part	Very poor	Very poor	Poor	Poor	Poor	Poor
Millsholm:						
164	Poor	Fair	Fair			Poor
165	Very poor	Very poor	Poor			Poor
Montara:						
166, 167	Very poor	Very poor	Poor			Fair
Perkins:						
168, 169	Good	Good	Good			Good
Pleasanton:						
170, 171	Good	Good	Good			Good
Reyes:						
172	Poor	Fair	Good			Good
173	Very poor	Very poor	Very poor			Very poor
Riverwash:						
174.						
Rock outcrop:						
175.						
[1] 176:						
Rock outcrop part.						
Hambright part	Very poor	Very poor	Fair			Fair
[1] 177:						
Rock outcrop part.						
Kidd part	Very poor	Very poor	Poor			Fair
Sobrante:						
178	Poor	Fair	Good			Good
179	Very poor	Poor	Good			Good

See footnote at end of table.

habitat potentials—Continued

Potential for habitat elements—Continued		Potential as habitat for—			
Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Good	Poor	Good		Fair	Good.
Poor	Very poor	Fair		Very poor	Good.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor		Very poor	Fair.
Very poor	Very poor	Very poor		Very poor	Fair.
Very poor	Very poor	Very poor		Very poor	Poor.
Very poor	Very poor	Poor		Very poor	Poor.
Very poor	Very poor	Very poor		Very poor	Poor.
Very poor	Very poor	Very poor	Poor	Very poor	
Very poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Poor	Fair	Very poor	
Very poor	Very poor	Fair		Very poor	Good.
Very poor	Very poor	Fair		Very poor	Good.
Very poor	Very poor	Very poor		Very poor	Good.
Poor	Very poor	Fair		Very poor	Fair.
Very poor	Very poor	Fair	Very poor	Very poor	Fair.
Very poor	Very poor	Very poor	Good	Very poor	Fair.
Very poor	Very poor	Fair	Very poor	Very poor	Fair.
Very poor	Very poor	Very poor		Very poor	Poor.
Very poor	Very poor	Very poor	Poor	Very poor	
Very poor	Very poor	Poor		Very poor	Poor.
Very poor	Very poor	Very poor		Very poor	Poor.
Very poor	Very poor	Very poor		Very poor	Poor.
Very poor	Very poor	Good		Very poor	Good.
Poor	Very poor	Good		Poor	Good.
Fair	Fair	Fair		Fair	Good.
Poor	Good	Very poor		Fair	Very poor.
Very poor	Very poor	Very poor		Very poor	Fair.
Very poor	Very poor	Very poor		Very poor	Poor.
Very poor	Very poor	Good	Good	Very poor	Good.
Very poor	Very poor	Poor	Fair	Very poor	Good.

TABLE 4.—*Wildlife*

Soil name and map symbol	Potential for habitat elements					
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs
Tehama:						
180	Good	Good	Good			Good
Yolo:						
181	Good	Good	Good			Good
182	Good	Good	Good			Good

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of

location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

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

The information in table 5 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 6, and interpretations for dwellings without basements and for local roads and streets, given in table 7.

Camp areas require such site preparation as shaping and leveling for 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 for this use 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 camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as 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 will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

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

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction materials and water management. Among those who can benefit from this section are engineers, landowners, community decision makers and planners, town and city managers, land developers, builders, contractors and farmers and ranchers.

The ratings in tables in this section are based on test data and estimated data in the "Soil Properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by the soil survey and used in determining the ratings in this section are grain-size distribution, liquid limit, plasticity index, soil reaction, depth to and hardness of bedrock within 5 or 6 feet of the surface, soil wetness characteristics, depth to a seasonal water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

Based on the information assembled about soil properties, ranges of values may be estimated for erodi-

habitat potentials—Continued

Potential for habitat elements—Continued		Potential as habitat for—			
Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Poor	Very poor	Good		Very poor	Good.
Good	Good	Good	Good	Good	Good.
Poor	Very poor	Good	Good	Very poor	Good.

the whole mapping unit.

TABLE 5.—*Recreational development*

["Percs slowly" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Aiken:				
100	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope	Slight.
101	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
102	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Bale:				
103	Moderate: floods	Slight	Slight	Slight.
104	Moderate: floods, too clayey.	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey.
105	Moderate: floods, too clayey.	Moderate: too clayey	Moderate: slope, too clayey.	Moderate: too clayey.
[1]106:				
Bale loam part	Moderate: wetness, floods.	Moderate: wetness	Severe: wetness	Moderate: wetness.
Bale clay loam part	Moderate: wetness, floods, too clayey.	Moderate: wetness, too clayey.	Severe: wetness	Moderate: wetness, too clayey.
Boomer:				
107	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope	Slight.
108	Severe: slope	Severe: slope	Severe: slope, small stones.	Moderate: slope, small stones.
109	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.
[1]110:				
Boomer part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
Forward part	Severe: slope	Severe: slope	Severe: slope, small stones.	Moderate: slope, small stones.
Felta part	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.
[1]111:				
Boomer part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Forward part	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.
Felta part	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope, small stones.
Bressa:				
[1]112:				
Bressa part	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope	Slight.
Dibble part	Moderate: slope, percs slowly, too clayey.	Moderate: slope, too clayey.	Severe: slope	Moderate: too clayey.
[1]113:				
Bressa part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope
Dibble part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope, too clayey.
[1]114, [1]115:				
Bressa part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Dibble part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.

See footnote at end of table.

TABLE 5.—*Recreational development—Continued*

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Clear Lake:				
116	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
117	Severe: floods	Moderate: floods	Moderate: floods	Slight.
Cole:				
118, 119	Moderate: wetness, percs slowly.	Moderate: wetness	Moderate: wetness, percs slowly.	Moderate: wetness.
Contra Costa:				
120	Moderate: slope, percs slowly.	Moderate: slope	Severe: slope	Slight.
121	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Moderate: small stones.
Coombs:				
122,123	Moderate: small stones.	Moderate: small stones.	Severe: small stones	Moderate: small stones.
Cortina:				
124	Severe: small stones	Severe: small stones	Severe: small stones	Severe: small stones.
125	Moderate: large stones	Slight	Severe: large stones	Moderate: large stones.
Diablo:				
126, 127	Severe: too clayey	Severe: too clayey	Severe: slope, too clayey.	Severe: too clayey.
128	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey.
129	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey.	Severe: too clayey, slope.
Egbert:				
130	Severe: wetness, floods	Severe: wetness, floods	Severe: floods, wetness	Severe: floods, wetness
Fagan:				
131	Moderate: slope, too clayey, percs slowly.	Moderate: slope, too clayey.	Severe: slope	Moderate: too clayey.
132	Severe: slope	Severe: slope	Severe: slope	Moderate: slope, too clayey.
133,134	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Felton:				
135, 136, 137	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.
Forward:				
138	Moderate: small stones.	Moderate: small stones.	Severe: small stones	Moderate: small stones.
139	Severe: slope	Severe: slope	Severe: slope, small stones.	Moderate: slope, small stones.
140	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.
[1]141:				
Forward part	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.
Kidd part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Guenoc:				
142	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
[1]143:				
Guenoc part	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
Rock outcrop part.				
[1]144:				
Guenoc part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Rock outcrop part.				
Haire:				
145, 146	Severe: percs slowly	Moderate: dusty	Severe: percs slowly	Moderate: dusty.
147, 148	Severe: percs slowly	Moderate: too clayey	Severe: percs slowly	Moderate: too clayey.
149	Severe: percs slowly	Moderate: too clayey, slope.	Severe: slope, percs slowly.	Moderate: too clayey.
150	Severe: slope, percs slowly.	Severe: slope	Severe: slope, percs slowly.	Moderate: too clayey, slope.
Hambright:				
[1]151:				
Hambright part	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones, depth to rock.	Severe: large stones.
Rock outcrop part.				
[1]152:				
Hambright part	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones.
Rock outcrop part.				
Henneke:				
153	Severe: slope	Severe: slope	Severe: slope, small stones.	Moderate: slope, small stones.
154	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.

See footnote at end of table.

TABLE 5.—*Recreational development—Continued*

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Kidd:				
155	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: slope.
156	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Lodo:				
[1]157:				
Lodo part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Maymen part	Severe: slope	Severe: slope	Severe: slope, small stones, depth to rock.	Severe: slope.
Felton part	Severe: slope	Severe: slope	Severe: slope, small stones.	Severe: slope.
Los Gatos:				
158	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
159, 160	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Maxwell:				
161	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Maymen:				
[1]162:				
Maymen part	Severe: slope	Severe: slope	Severe: slope, small stones, depth to rock.	Severe: slope.
Los Gatos part	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
[1]163:				
Maymen part	Severe: slope	Severe: slope	Severe: slope, small stones, depth to rock.	Severe: slope.
Millsholm part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Lodo part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Millsholm:				
164	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate: slope.
165	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Montara:				
166	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Moderate slope.
167	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Perkins:				
168	Moderate: small stones, percs slowly.	Moderate: small stones.	Severe: small stones	Moderate: small stones.
169	Moderate: small stones, percs slowly.	Moderate: small stones	Severe: slope, small stones.	Moderate: small stones.
Pleasanton:				
170	Moderate: percs slowly.	Slight	Moderate: percs slowly, small stones.	Slight.
171	Moderate: percs slowly.	Slight	Moderate: slope, small stones, percs slowly.	Slight.
Reyes:				
172, 173	Severe: floods, wetness	Severe: floods, wetness	Severe: floods, wetness	Severe: floods, wetness.
Riverwash:				
174	Severe: wetness, floods	Severe: wetness, floods	Severe: wetness, floods	Severe: wetness, floods.
Rock outcrop:				
175.				
[1]176:				
Rock outcrop.				
Hambright part	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones, depth to rock.	Severe: slope, large stones.
[1]177:				
Rock outcrop part.				
Kidd part	Severe: slope	Severe: slope	Severe: slope, depth to rock.	Severe: slope.
Sobrante:				
178	Severe: slope	Severe: slope	Severe: slope	Moderate: slope.
179	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Tehama:				
180	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Yolo:				
181	Slight	Slight	Slight	Slight.
182	Slight	Slight	Moderate: slope	Slight.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

bility, permeability, corrosivity, shrink-well potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values may be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems and other engineering works. The ranges of values can be used to—(1) select potential residential, commercial, industrial and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternate routes for roads, streets, highways, pipelines and underground cables; (4) evaluate alternate sites for location of sanitary landfills, onsite sewage disposal systems and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations and testing.

The information is presented mainly in tables. Table 7 shows, for each kind of soil, ratings of the degree and kind of limitations for building site development; table 6, for sanitary facilities; and table 9, for water management. Table 8 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have different meanings in soil science and in engineering; the Glossary defines many of these terms.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that deal with the ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 6 shows the degree and kind of limitations of each soil for these uses and for use of the soil as daily cover for landfills.

If the degree of soil limitation is indicated by the rating *slight*, soils are favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs or intensive maintenance are required.

Septic absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that effect the absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock and susceptibility to flooding. Stones, boulders and a shallow depth to bedrock interfere with installation. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas. Also, soil erosion and soil slippage are hazards where absorption fields are installed in sloping soils.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and as a result ground water supplies in the area may be contaminated.

Percolation tests are performed to determine the absorptive capacity of the soil and its suitability for septic tank absorption fields. These tests should be performed during the season when the water table is highest and the soil is at minimum absorptive capacity.

In many of the soils that have moderate or severe limitations for septic tank absorption fields, it may be possible to install special systems that lower the seasonal water table or to increase the size of the absorption field so that satisfactory performance is achieved.

Sewage lagoons are shallow ponds constructed to hold sewage while bacteria decompose the solid and liquid wastes. Lagoons have a nearly level flow area surrounded by cut slopes or embankments of compacted, nearly impervious soil material. They generally are designed so that depth of the sewage is 2 to 5 feet. Impervious soil, at least 4 feet thick for the lagoon floor and sides, is required to minimize seepage and contamination of local ground water. Soils that are very high in organic matter and those that have stones and boulders are undesirable. Unless the soil has very slow permeability, contamination of local ground water is a hazard in areas where the seasonal high water table is above the lagoon floor. In soils where the water

TABLE 6.—*Sanitary facilities*

["Depth to rock" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Aiken:					
100	Severe: depth to rock, percs slowly.	Severe: slope	Severe: depth to rock.	Moderate: slope	Fair: slope, too clayey.
101	Severe: slope, depth to rock, percs slowly.	Severe: slope	Severe: depth to rock.	Severe: slope	Poor: slope.
102	Severe: slope, depth to rock, percs slowly.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Bale:					
103	Moderate: percs slowly, floods, wetness.	Severe: seepage	Severe: wetness seepage.	Severe: seepage	Good.
104, 105	Moderate: percs slowly, floods, wetness.	Severe: seepage	Severe: wetness, seepage.	Severe: seepage.	Fair: too clayey.
[1]106:					
Bale loam part	Severe: wetness	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Good.
Bale clay loam part.	Severe: wetness	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Fair: too clayey.
Boomer:					
107	Severe: percs slowly.	Severe: slope	Severe: depth to rock.	Moderate: slope	Fair: slope.
108	Severe: slope, percs slowly.	Severe: slope	Severe: depth to rock.	Severe: slope	Poor: slope.
109	Severe: slope, percs slowly.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
[1]110:					
Boomer part	Severe: slope, percs slowly.	Severe: slope	Severe: depth to rock.	Severe: slope	Poor: slope.
Forward part	Severe: slope, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: slope, seepage.	Poor: slope.
Felta part	Severe: slope	Severe: small stones, slope.	Moderate: slope	Severe: slope	Poor: small stones, slope.
Boomer:					
[1]111:					
Boomer part	Severe: slope, percs slowly.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Forward part	Severe: slope, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: slope, seepage.	Poor: slope.
Felta part	Severe: slope	Severe: small stones, slope.	Severe: slope	Severe: slope	Poor: small stones, slope.
Bressa:					
[1]112:					
Bressa part	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope	Fair: slope, thin layer, area reclaim.
Dibble part	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, too clayey.	Moderate: slope	Poor: too clayey.
[1]113:					
Bressa part	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope.
Dibble part	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, too clayey.	Severe: slope	Poor: slope, too clayey.
[1]114, [1]115:					
Bressa part	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Dibble part	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, too clayey.	Severe: slope	Poor: slope, too clayey.

See footnote at end of table.

TABLE 6.—*Sanitary facilities—Continued*

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Clear Lake:					
116	Severe: percs slowly.	Slight	Severe: too clayey	Slight	Poor: too clayey.
117	Severe: wetness, floods.	Severe: floods	Severe: floods, wetness.	Severe: floods	Poor: too clayey.
Cole:					
118	Severe: percs slowly, wetness.	Moderate: wetness	Severe: wetness	Moderate: wetness	Fair: too clayey.
119	Severe: percs slowly, wetness.	Moderate: slope, wetness.	Severe: wetness	Moderate: wetness	Fair: too clayey.
Contra Costa:					
120, 121	Severe: percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope	Poor: too clayey.
Coombs:					
122	Severe: percs slowly.	Severe: seepage	Severe: seepage	Slight	Fair: too clayey.
123	Severe: percs slowly.	Severe: slope, seepage.	Severe: seepage	Slight	Fair: too clayey.
Cortina:					
124	Slight	Severe: seepage, small stones.	Severe: seepage	Severe: seepage	Poor: small stones.
125	Moderate: large stones.	Severe: seepage, large stones, small stones.	Severe: seepage	Severe: seepage	Poor: large stones, small stones.
Diablo:					
126, 127	Severe: percs slowly.	Severe: slope	Severe: depth to rock, too clayey.	Moderate: slope	Poor: too clayey.
128	Severe: slope, percs slowly.	Severe: slope	Severe: depth to rock, too clayey.	Severe: slope	Poor: slope, too clayey.
129	Severe: slope, percs slowly.	Severe: slope	Severe: slope, depth to rock, too clayey.	Severe: slope	Poor: slope, too clayey.
Egbert:					
130	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness, too clayey.
Fagan:					
131	Severe: percs slowly, depth to rock.	Severe: slope	Severe: depth to rock, too clayey.	Moderate: slope	Fair: slope, too clayey.
132	Severe: slope, percs slowly, depth to rock.	Severe: slope	Severe: depth to rock, too clayey.	Severe: slope	Poor: slope.
133, 134	Severe: slope, percs slowly, depth to rock.	Severe: slope	Severe: slope, depth to rock, too clayey.	Severe: slope	Poor: slope.
Felton:					
135	Severe: slope, percs slowly, depth to rock.	Severe: slope	Severe: depth to rock.	Severe: slope	Poor: slope.
136, 137	Severe: slope, percs slowly, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Forward:					
138	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: seepage	Fair: small stones, thin layer, area reclaim.
Forward:					
139	Severe: slope, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: slope, seepage.	Poor: slope.
140	Severe: slope, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: slope, seepage.	Poor: slope.
[1]141:					
Forward part	Severe: slope, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: slope, seepage, depth to rock.	Severe: slope, seepage.	Poor: slope.
Kidd part	Severe: slope, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: slope, depth to rock, seepage.	Severe: slope, seepage.	Poor: slope, thin layer, area reclaim.

See footnote at end of table.

TABLE 6.—*Sanitary facilities—Continued*

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Guenoc:					
142	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
[1]143:					
Guenoc part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope.
Rock outcrop part.					
[1]144:					
Guenoc part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Rock outcrop part.					
Haire:					
145, 147	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
146, 148	Severe: percs slowly.	Moderate: slope	Moderate: too clayey.	Slight	Fair: too clayey.
149	Severe: percs slowly.	Severe: slope	Moderate: too clayey.	Moderate: slope	Fair: slope, too clayey.
150	Severe: slope, percs slowly.	Severe: slope	Moderate: slope, too clayey.	Severe: slope	Poor: slope.
Hambright:					
[1]151:					
Hambright part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope	Poor: slope, thin layer, large stones.
Rock outcrop part.					
[1]152:					
Hambright part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope	Poor: slope, thin layer, large stones.
Rock outcrop part.					
Henneke:					
153	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: thin layer, slope, area reclaim.
154	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope	Poor: thin layer, slope, area reclaim.
Kidd:					
155	Severe: slope, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: slope, seepage.	Poor: slope, thin layer, area reclaim.
156	Severe: slope, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: slope, depth to rock, seepage.	Severe: slope, seepage.	Poor: slope, thin layer, area reclaim.
Lodo:					
[1]157:					
Lodo part	Severe: slope, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: depth to rock, slope, seepage.	Severe: slope, seepage.	Poor: slope, thin layer, area reclaim.
Maymen part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Felton part	Severe: slope, percs slowly, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Los Gatos:					
158	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope.
159, 160	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Maxwell:					
161	Severe: percs slowly.	Slight	Severe: too clayey	Slight	Poor: too clayey.

See footnote at end of table.

TABLE 6.—*Sanitary facilities—Continued*

Soil name and map symbol	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Maymen:					
[1]162:					
Maymen part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Los Gatos part	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
[1]163:					
Maymen part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Millsholm part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Lodo part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope	Poor: slope, thin layer, area reclaim.
Millsholm:					
164	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
165	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Montara:					
166, 167	Severe: slope, depth to rock, percs slowly.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope, thin layer, area reclaim.
Perkins:					
168	Severe: percs slowly.	Moderate: slope, small stones.	Moderate: too clayey.	Slight	Fair: small stones, too clayey.
169	Severe: percs slowly.	Severe: slope	Moderate: too clayey.	Slight	Fair: small stones, too clayey.
Pleasanton:					
170	Severe: percs slowly.	Slight	Slight	Slight	Good.
171	Severe: percs slowly.	Moderate: slope	Slight	Slight	Good.
Reyes:					
172, 173	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey, area reclaim.
Riverwash:					
174	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
Rock outcrop:					
175.					
[1]176:					
Rock outcrop part.					
Hambright part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope	Poor: slope, thin layer, large stones.
[1]177:					
Rock outcrop part.					
Kidd part	Severe: slope, depth to rock.	Severe: slope, depth to rock, seepage.	Severe: slope, depth to rock, seepage.	Severe: slope, seepage.	Poor: slope, thin layer, area reclaim.
Sobrante:					
178	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope	Poor: slope.
179	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope	Poor: slope.
Tehama:					
180	Severe: percs slowly.	Moderate: slope	Moderate: too clayey.	Slight	Fair: too clayey.
Yolo:					
181	Moderate: percs slowly.	Moderate: seepage	Slight	Slight	Good.
182	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

table is seasonally high, seepage of ground water into the lagoon can seriously reduce its capacity for liquid waste. Slope, depth to bedrock and susceptibility to flooding also affect the location of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soils affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste, either in excavated trenches or on the surface of the soil. The waste is spread, compacted in layers, and covered with thin layers of soil. Landfill areas are subject to heavy vehicular traffic. Ease of excavation, risk of polluting ground water, and trafficability affect the suitability of a soil for this purpose. The best soils have a loamy or silty texture, have moderate or slow permeability, are deep to bedrock and a seasonal water table, are free of large stones and boulders, and are not subject to flooding. In areas where the seasonal water table is high, water seeps into the trenches and causes problems in excavating and filling the trenches. Also, seepage into the refuse increases the risk of pollution of ground water. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability that might allow noxious liquids to contaminate local ground water.

Unless otherwise stated, the ratings in table 6 apply only to soil properties and features within a depth of about 6 feet. If the trench is deeper, ratings of slight or moderate may not be valid. Site investigation is needed before a site is selected.

In the area type of sanitary landfill, refuse is placed on the surface of the soil in successive layers. The limitations caused by soil texture, depth to bedrock and stone content do not apply to this type of landfill. Soil wetness, however, may be a limitation because of difficulty in operating equipment.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill during both wet and dry weather. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

In addition to these features, the soils selected for final cover of landfills should be suitable for growing plants. In comparison with other horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth of a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas, such as slope, erodibility and potential for plant growth.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 7. A *slight* limitation indicates that soil properties are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are used for pipelines, sewerlines, telephone and power transmission lines, basements, open ditches and cemeteries. Such digging or trenching is influenced by the soil wetness caused by seasonal high water table, the texture and consistence of soils, the tendency of soils to cave in or slough, and the presence of very firm, dense soil layers, bedrock or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is defined, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and small commercial buildings referred to in table 7 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence from settling or shear failure of the foundation do not occur. These ratings were determined from estimates of the shear strength, compressibility and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns and gardens. Depth to bedrock, slope and the large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious limitation.

Local roads and streets referred to in table 7 have an all-weather surface that can carry light to medium traffic all year. They consist of subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The AASHTO and Unified classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and

TABLE 7.—*Building site development*

["Depth to rock" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Aiken:					
100	Moderate: slope, depth to rock, too clayey.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, depth to rock, shrink-swell.	Severe: slope	Severe: low strength.
101, 102	Severe: too clayey	Severe: slope	Severe: slope	Severe: slope	Severe: slope, low strength.
Bale:					
103	Moderate: wetness, floods.	Severe: floods	Severe: floods	Severe: floods	Moderate: low strength.
104, 105	Moderate: wetness, floods.	Severe: floods	Severe: floods	Severe: floods	Severe: low strength.
[1]106:					
Bale loam part	Severe: wetness	Severe: floods	Severe: wetness, floods.	Severe: floods	Moderate: wetness, low strength.
Bale clay loam part.	Severe: wetness	Severe: floods	Severe: wetness, floods.	Severe: floods	Severe: low strength.
Boomer:					
107	Moderate: slope, depth to rock, too clayey.	Moderate: slope, shrink-swell, low strength.	Moderate: slope, depth to rock, shrink-swell.	Severe: slope	Severe: low strength.
108, 109	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, low strength.
[1]110, [1]111:					
Boomer part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope, low strength.
Forward part	Severe: slope, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Severe: slope.
Felta part	Severe: slope, small stones.	Severe: slope	Severe: slope	Severe: slope	Severe slope.
Bressa:					
[1]112:					
Bressa part	Severe: depth to rock.	Moderate: slope, depth to rock, shrink-swell.	Severe: depth to rock.	Severe: slope	Severe: low strength.
Dibble part	Severe: depth to rock, too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: low strength, shrink-swell.
[1]113, [1]114, [1]115:					
Bressa part	Severe: slope, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Severe: slope, low strength.
Dibble part	Severe: slope, depth to rock, too clayey.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.
Clear Lake:					
116	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
117	Severe: floods, wetness, too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell, low strength.	Severe: wetness, floods, shrink-swell.
Cole:					
118, 119	Severe: wetness	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Contra Costa:					
120	Severe: depth to rock, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, depth to rock, low strength.	Severe: slope, shrink-swell, low strength.	Severe: low strength, shrink-swell.
121	Severe: depth to rock, too clayey.	Moderate: slope, depth to rock, shrink-swell.	Severe: depth to rock.	Severe: slope	Severe: low strength.
Coombs:					
122, 123	Moderate: small stones, too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
Cortina:					
124	Severe: small stones.	Slight	Slight	Slight	Slight.
125	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.	Severe: large stones.

See footnote at end of table.

TABLE 7.—*Building site development—Continued*

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Diablo:					
126	Severe: depth to rock, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
127	Severe: depth to rock, too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, low srtength.
128, 129	Severe: depth to rock, too clayey, slope.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, low strength, slope.
Egbert:					
130	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness.	Severe: floods, wetness, low strength.
Fagan:					
131	Severe: too clayey	Severe: shrink-swell.	Severe: shrink-swell.	Severe: slope, shrink-swell.	Severe: low strength, shrink-swell.
132, 133, 134	Severe: slope, too clayey.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell.	Severe: slope, low strength, shrink-swell.
Felton:					
135, 136, 137	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Forward:					
138	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: low strength.
139, 140	Severe: slope, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Severe: slope.
[1]141:					
Forward part	Severe: slope, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Severe: slope.
Kidd part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Guenoc:					
142	Severe: slope, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Severe: slope.
[1]143, [1]144					
Guenoc part	Severe: slope, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Severe: slope.
Rock outcrop part.					
Haire:					
145, 146, 147, 148	Moderate: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
149	Moderate: slope, too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: slope	Severe: low strrength, shrink-swell.
150	Severe: slope	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.
Hambright:					
[1]151, [1]152:					
Hambright part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.
Rock outcrop part.					
Henneke:					
153, 154	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
Kidd:					
155, 156	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Lodo:					
[1]157:					
Lodo part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, low strength.
Maymen part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Felton part	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope.
Los Gatos:					
158, 159 160	Severe: slope, depth to rock.	Severe: slope	Severe: slope, depth to rock.	Severe: slope	Severe: slope, low strength.

See footnote at end of table.

TABLE 7.—*Building site development—Continued*

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Maxwell: 161	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Maymen: [1]162:					
Maymen part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Los Gatos part	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, low strength.
[1]163:					
Maymen part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Millsholm part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
Lodo part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, low strength.
Millsholm: 164, 165	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Montara: 166, 167	Severe: slope, depth to rock.	Severe: slope, depth to rock, low strength.	Severe: slope, depth to rock, low strength.	Severe: slope, depth to rock, low strength.	Severe: slope, depth to rock, low strength.
Perkins: 168, 169	Moderate: too clayey, small stones.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
Pleasanton: 170, 171	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
Reyes: 172, 173	Severe: floods, wetness, too clayey.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, low strength.
Riverwash: 174.					
Rock outcrop: 175.					
[1]176: Rock outcrop part. Hambright part	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: slope, depth to rock, large stones.
[1]177: Rock outcrop part. Kidd part	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Sobrante: 178, 179	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.
Tehama: 180	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
Yolo: 181, 182	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

content of large stones, all of which affect stability and ease of excavation, were also considered.

Construction materials

The suitability of each soil as a source of road fill, sand, gravel and topsoil is indicated in table 8 by ratings of good, fair or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed and described as the survey is made, generally about 6 feet.

Road fill is soil material used in embankments for roads. The ratings reflect the ease of excavating and working the material and the expected performance of the material after it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about soil properties that determine such performance is given in the descriptions of soil series.

The ratings apply to the soil profile between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within the profile. The estimated engineering properties in table 10 provide more specific information about the nature of each horizon that can help to determine its suitability for road fill.

Soils rated *good* have low shrink-swell potential, low potential frost action and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as high shrink-swell potential, high potential frost action, steep slopes, wetness or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*, regardless of the quality of the suitable material.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 8 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bed-rock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction and stratification are given in the soil series descriptions and in table 10.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to sustain the growth of plants. Also considered is the damage that would result to the area from which the topsoil is taken.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones, are low in content of gravel and other coarse fragments, and have gentle slopes. They are low in soluble salts, which can limit plant growth. They are naturally fertile or respond well to fertilization. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones or soluble salts.

Soils rated *poor* are very sandy soils, very firm clayey soils, soils with suitable layers less than 8 inches thick, soils having large amounts of gravel, stones or soluble salt, steep soil and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter a surface horizon is much preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter. Consequently, careful preservation and use of material from these horizons is desirable.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 9, the soil and site features

TABLE 8.—*Construction materials*

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Aiken:				
100	Fair: low strength, shrink-swell	Unsuited	Unsuited	Fair: too clayey, slope.
101, 102	Fair: slope, shrink-swell, low strength	Unsuited	Unsuited	Poor: slope.
Bale:				
103	Fair: low strength	Poor: excess fines.	Unsuited	Good.
104, 105	Fair: low strength	Poor: excess fines.	Unsuited	Fair: too clayey.
[1]106:				
Bale loam part	Fair: wetness, low strength	Unsuited	Unsuited	Poor: excess salts.
Bale clay loam part.	Fair: low strength, wetness	Unsuited	Unsuited	Poor: excess salts.

See footnote at end of table.

TABLE 8.—*Construction materials—Continued*

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Boomer:				
107	Poor: low strength	Unsuited	Unsuited	Fair: too clayey.
108	Poor: low strength	Unsuited	Unsuited	Poor: small stones, slope.
109	Poor: slope, low strength	Unsuited	Unsuited	Poor: small stones, slope.
[1]110:				
Boomer part	Poor: low strength	Unsuited	Unsuited	Poor: slope, thin layer.
Forward part	Poor: thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones.
Felta part	Fair: slope	Unsuited	Unsuited	Poor: small stones, slope.
[1]111:				
Boomer part	Poor: slope, low strength	Unsuited	Unsuited	Poor: slope, thin layer.
Forward part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones.
Felta part	Poor: slope	Unsuited	Unsuited	Poor: small stones, slope.
Bressa:				
[1]112:				
Bressa part	Fair: low strength, thin layer	Unsuited	Unsuited	Fair: slope, too clayey.
Dibble part	Poor: low strength, shrink-swell	Unsuited	Unsuited	Poor: too clayey.
[1]113:				
Bressa part	Fair: slope, low strength, thin layer	Unsuited	Unsuited	Poor: slope.
Dibble part	Poor: slope, low strength, shrink-swell	Unsuited	Unsuited	Poor: slope, too clayey.
[1]114, [1]115				
Bressa part	Poor: slope	Unsuited	Unsuited	Poor: slope.
Dibble part	Poor: slope, low strength, shrink-swell.	Unsuited	Unsuited	Poor: slope, too clayey.
Clear Lake:				
[1]116	Poor: low strength, shrink-swell	Unsuited	Unsuited	Poor: too clayey.
117	Poor: shrink-swell, low strength, wetness.	Unsuited	Unsuited	Poor: too clayey, wetness.
Cole:				
118,119	Poor: low strength	Unsuited	Unsuited	Fair: too clayey.
Contra Costa:				
120	Poor: low strength, shrink-swell, thin layer.	Unsuited	Unsuited	Fair: slope, too clayey.
121	Poor: thin layer, low strength	Unsuited	Unsuited	Poor: small stones.
Coombs:				
122, 123	Poor: low strength	Unsuited	Unsuited	Poor: small stones.
Cortina:				
124	Good	Unsuited	Fair: excess fines.	Poor: small stones.
125	Poor: large stones	Unsuited	Unsuited: large stones.	Poor: large stones.
Diablo:				
126, 127	Poor: shrink-swell, low strength	Unsuited	Unsuited	Poor: too clayey.
128	Poor: shrink-swell, low strength	Unsuited	Unsuited	Poor: slope, too clayey.
129	Poor: slope, shrink-swell, low strength	Unsuited	Unsuited	Poor: slope, too clayey.
Egbert:				
130	Poor: wetness, low strength, shrink-swell.	Unsuited	Unsuited	Poor: wetness.
Fagan:				
131	Poor: low strength, shrink-swell	Unsuited	Unsuited	Fair: slope, too clayey.
132	Poor: low strength, shrink-swell	Unsuited	Unsuited	Poor: slope.
133, 134	Poor: slope, low strength, shrink-swell	Unsuited	Unsuited	Poor: slope.
Felton:				
135, 136, 137	Poor: slope	Unsuited	Unsuited	Poor: slope, small stones.
Forward:				
138	Poor: thin layer, area reclaim	Unsuited	Unsuited	Poor: small stones.
139	Poor: thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones.
140	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones.
[1]141:				
Forward part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones.
Kidd part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, area reclaim.
Guenoc:				
142	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope.
[1]143:				
Guenoc part, Rock outcrop part.	Poor: thin layer, area reclaim	Unsuited	Unsuited	Poor: slope.
[1]144:				
Guenoc part, Rock outcrop part.	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope.
Haire:				
145, 146	Poor: low strength	Unsuited	Unsuited	Good.
147, 148	Poor: low strength	Unsuited	Unsuited	Fair: too clayey.
149	Poor: low strength	Unsuited	Unsuited	Fair: too clayey, slope.
150	Poor: low strength	Unsuited	Unsuited	Poor: slope.

See footnote at end of table.

TABLE 8.—*Construction materials—Continued*

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Hambright:				
[1]151:				
Hambright part	Poor: large stones, thin layer, area reclaim.	Unsuited	Unsuited	Poor: slope, large stones, area reclaim.
Rock outcrop part.				
[1]152:				
Hambright part	Poor: slope, large stones, depth to rock.	Unsuited	Unsuited	Poor: slope, large stones, area reclaim.
Rock outcrop part.				
Henneke:				
153	Poor: thin layer, low strength, area reclaim.	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
154	Poor: thin layer, slope, area reclaim	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Kidd:				
155	Poor: thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, area reclaim.
156	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, area reclaim.
Lodo:				
[1]157:				
Lodo part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, thin layer, area reclaim.
Maymen part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Felton part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones.
Los Gatos:				
158	Poor: thin layer, low strength	Unsuited	Unsuited	Poor: slope.
159, 160	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope.
Maxwell:				
161	Poor: low strength, shrink-swell	Unsuited	Unsuited	Poor: too clayey.
Maymen:				
[1]162:				
Maymen part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Los Gatos part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope.
[1]163:				
Maymen part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, small stones, area reclaim.
Millsholm part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, area reclaim.
Lodo part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, area reclaim.
Millsholm:				
164	Poor: thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, area reclaim.
165	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, area reclaim.
Montara:				
166, 167	Poor: slope, low strength, thin layer	Unsuited	Unsuited	Poor: slope, area reclaim.
Perkins:				
168, 169	Poor: low strength	Unsuited	Unsuited	Poor: small stones.
Pleasanton:				
170, 171	Poor: low strength	Unsuited	Unsuited	Good.
Reyes:				
172	Poor: low strength, shrink-swell, wetness.	Unsuited	Unsuited	Poor: wetness, excess salt.
173	Poor: wetness, low strength, shrink-swell.	Unsuited	Unsuited	Poor: wetness, excess salt.
Riverwash:				
174.				
Rock outcrop:				
175.				
[1]176:				
Rock outcrop part.				
Hambright part	Poor: slope, large stones, depth to rock.	Unsuited	Unsuited	Poor: slope, large stones, area reclaim.
[1]177:				
Rock outcrop part.				
Kidd part	Poor: slope, thin layer, area reclaim	Unsuited	Unsuited	Poor: slope, area reclaim.
Sobrante:				
178	Poor: thin layer, low strength, area reclaim.	Unsuited	Unsuited	Poor: slope.
179	Poor: slope, thin layer, low strength	Unsuited	Unsuited	Poor: slope.
Tehama:				
180	Poor: low strength	Unsuited	Unsuited	Good.
Yolo:				
181, 182	Poor: low strength	Unsuited	Unsuited	Good.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

TABLE 9.—*Water management*

["Seepage," and some of the other terms that describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Aiken:						
100, 101, 102	Depth to rock, slope.	Shrink-swell, low strength, compressible.	Depth to rock, complex slope.	Complex slope	Depth to rock, complex slope.	Slope.
Bale:						
103, 104	Favorable	Piping, low strength.	Favorable	Favorable	Piping	Favorable.
105	Slope	Piping, low strength.	Slope	Slope	Slope, piping	Slope.
[1]106	Favorable	Piping, low strength.	Wetness	Wetness, excess salts.	Wetness, piping.	Wetness.
Boomer:						
107, 108, 109	Slope, depth to rock.	Low strength, shrink-swell.	Slope, depth to rock.	Slope	Slope, depth to rock.	Slope.
[1]110, [1]111:						
Boomer part	Slope, depth to rock.	Low strength, shrink-swell.	Slope, depth to rock.	Slope	Slope, depth to rock.	Slope.
Forward part	Slope, depth to rock, seepage.	Thin layer	Complex slope, depth to rock.	Complex slope, rooting depth, droughty.	Complex slope, rooting depth, depth to rock.	Slope, droughty.
Felta part	Slope, seepage	Piping	Complex slope	Complex slope, droughty.	Slope, piping	Slope, droughty.
Bressa:						
[1]112, [1]113, [1]114, [1]115:						
Bressa part	Slope, depth to rock.	Piping, thin layer, low strength.	Slope, depth to rock.	Slope	Slope, depth to rock.	Slope.
Dibble part	Slope, depth to rock.	Low strength, compressible, shrink-swell.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.
Clear Lake:						
116	Favorable	Low strength, compressible, shrink-swell.	Percs slowly	Percs slowly, slow intake.	Percs slowly	Wetness, percs slowly.
117	Favorable	Low strength, shrink-swell, compressible.	Wetness, percs slowly, floods.	Wetness, floods, slow intake.	Wetness, percs slowly.	Wetness, percs slowly.
Cole:						
118	Favorable	Low strength, compressible, shrink-swell.	Wetness	Wetness	Wetness	Wetness.
119	Slope	Low strength, compressible, shrink-swell.	Slope, wetness	Slope, wetness	Wetness	Wetness.
Contra Costa:						
120	Slope, depth to rock.	Low strength, shrink-swell, thin layer.	Complex slope, depth to rock, percs slowly.	Complex slope, rooting depth, percs slowly.	Complex slope, depth to rock, percs slowly.	Slope, percs slowly.
121	Slope, depth to rock.	Low strength, shrink-swell, thin layer.	Slope, percs slowly, depth to rock.	Percs slowly, slope.	Slope, percs slowly, depth to rock.	Slope, percs slowly.
Coombs:						
122	Seepage	Low strength, shrink-swell.	Favorable	Favorable	Favorable	Favorable.
123	Slope, seepage	Low strength, shrink-swell.	Slope	Slope	Slope	Slope.
Cortina:						
124	Slope, seepage	Piping, seepage	Slope	Slope, droughty	Slope, piping	Slope, droughty.
125	Seepage	Piping, large stones.	Slope	Slope, droughty, large stones.	Slope, large stones, piping.	Slope, droughty, large stones.
Diablo:						
126, 127, 128, 129	Slope	Shrink-swell, low strength, compressible.	Complex slope, percs slowly.	Complex slope, percs slowly.	Complex slope, percs slowly.	Slope, percs slowly.
Egbert:						
130	Favorable	Low strength, shrink-swell.	Floods, wetness, percs slowly.	Floods, wetness, percs slowly.	Percs slowly, wetness.	Percs slowly, wetness.

See footnote at end of table.

TABLE 9.—*Water management—Continued*

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Fagan:						
131, 132, 133, 134	Slope, depth to rock.	Low strength, shrink-swell, compressible.	Slope, percs slowly, depth to rock.	slope, percs slowly.	Slope, percs slowly, depth to rock.	Slope, percs slowly.
Felton:						
135, 136, 137	Slope, depth to rock.	Low strength, shrink-swell, thin layer.	Slope, depth to rock.	Slope	Slope, depth to rock.	Slope.
Forward:						
138, 139, 140	Slope, depth to rock, seepage.	Thin layer, piping.	Complex slope, depth to rock.	Complex slope, rooting depth, droughty.	Complex slope, rooting depth, depth to rock.	Slope, droughty.
[1]141:						
Forward part	Slope, depth to rock, seepage.	Thin layer, piping.	Complex slope, depth to rock.	Complex slope, rooting depth, droughty.	Complex slope, rooting depth, depth to rock.	Slope, droughty.
Kidd part	Slope, depth to rock, seepage.	Thin layer, piping.	Complex slope, depth to rock.	Complex slope, rooting depth, droughty.	Complex slope, depth to rock, rooting depth.	Slope, rooting depth, droughty.
Guenoc:						
142	Slope, depth to rock.	Low strength, thin layer, shrink-swell.	Complex slope, depth to rock.	Complex slope, rooting depth.	Complex slope, depth to rock.	Slope.
[1]143:						
Guenoc part	Slope, depth to rock.	Low strength, thin layer, shrink swell.	Complex slope, depth to rock.	Complex slope, rooting depth.	Complex slope, depth to rock.	Slope.
Rock outcrop part.						
[1]144:						
Guenoc part	Slope, depth to rock.	Low strength, thin layer, shrink-swell.	Complex slope, depth to rock.	Complex slope, rooting depth.	Complex slope, depth to rock.	Slope.
Rock outcrop part.						
Haire:						
145, 146	Favorable	Low strength, compressible, shrink-swell.	Percs slowly	Percs slowly, slow intake.	Percs slowly	Percs slowly.
147, 148	Slope	Low strength, compressible, shrink-swell.	Slope, percs slowly.	Slope, percs slowly, slow intake.	Percs slowly	Slope, percs slowly.
149, 150	Slope	Low strength, compressible. shrink-swell.	Slope, percs slowly.	Slope, percs slowly, slow intake.	Slope, percs slowly.	Slope, percs slowly.
Hambright:						
[1]151, [1]152:						
Hambright part	Slope, depth to rock.	Large stones, thin layer, piping.	Slope, depth to rock, large stones.	Slope, rooting depth, large stones.	Slope, depth to rock, large stones.	Slope, large stones, rooting depth.
Rock outcrop part.						
Henneke:						
153, 154	Slope, depth to rock.	Thin layer, low strength.	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth droughty.
Kidd:						
155, 156	Slope, depth to rock, seepage.	Thin layer, piping.	Complex slope, depth to rock.	Complex slope, droughty, rooting depth.	Complex slope, depth to rock, rooting depth.	Slope, rooting depth, droughty.
Lodo:						
[1]157:						
Lodo part	Slope, depth to rock.	Thin layer, shrink-swell, low strength.	Complex slope, depth to rock.	Complex slope, rooting depth, droughty.	Complex slope, depth to rock.	Slope, rooting depth.
Maymen part	Slope, depth to rock.	Thin layer, low strength, piping.	Slope, depth to rock.	Slope, rooting depth, droughty.	Slope, depth to rock.	Slope, rooting depth, droughty.
Felton part	Slope, depth to rock.	Low strength, shrink-swell, thin layer.	Slope, percs slowly.	Slope	Slope, depth to rock.	Slope.
Los Gatos:						
158, 159, 160	Slope, depth to rock.	Low strength, thin layer, shrink-swell.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, depth to rock, percs slowly.	Slope, percs slowly.

See footnote at end of table.

TABLE 9.—*Water management—Continued*

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Maxwell:						
161	Slope	Compressible, low strength, shrink-swell.	Slope, percs slowly.	Slope, slow intake, percs slowly.	Percs slowly	Slope, percs slowly.
Maymen:						
[1]162:						
Maymen part	Slope, depth to rock.	Thin layer, low strength, piping.	Slope, depth to rock.	Slope, rooting depth, droughty.	Slope, depth to rock.	Slope, rooting depth, droughty.
Los Gatos part	Slope, depth to rock.	Low strength, thin layer, shrink-swell.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, depth to rock, percs slowly.	Slope, percs slowly.
[1]163:						
Maymen part	Slope, depth to rock.	Thin layer, low strength, piping.	Slope, depth to rock.	Slope, rooting depth, droughty.	Slope, depth to rock.	Slope, rooting depth, droughty.
Millsholm part	Slope, depth to rock.	Low strength, thin layer, piping.	Slope, depth to rock.	Slope, rooting depth, droughty.	Depth to rock, slope.	Slope, rooting depth.
Lodo part	Slope, depth to rock.	Thin layer, shrink-swell. low strength.	Complex slope, depth to rock.	Complex slope, rooting depth, droughty.	Complex slope, depth to rock.	Slope, rooting depth.
Millsholm:						
164, 165	Slope, depth to rock.	Low strength, thin layer, piping.	Slope, depth to rock.	Slope, rooting depth, droughty.	Depth to rock, slope.	Slope, rooting depth.
Montara:						
166, 167	Slope, depth to rock.	Low strength, thin layer, shrink-swell.	Slope, depth to rock.	Slope, rooting depth, droughty.	Slope, depth to rock.	Slope, rooting depth, droughty.
Perkins:						
168, 169	Slope	Compressible, low strength.	Percs slowly, slope.	Percs slowly, slope.	Percs slowly, slope.	Slope, percs slowly.
Pleasanton:						
170	Favorable	Low strength, shrink-swell.	Favorable	Favorable	Favorable	Favorable.
171	Slope	Low strength, shrink-swell.	Slope	Slope	Slope	Slope.
Reyes:						
172, 173	Favorable	Low strength, compressible, shrink-swell.	Excess salt, percs slowly, poor outlets.	Excess salt, slow intake, wetness.	Percs slowly, wetness, poor outlets.	Excess salt, percs slowly, wetness.
Riverwash:						
174.						
Rock outcrop:						
175.						
[1]176:						
Rock outcrop part.						
Hambright part	Slope, depth to rock.	Large stones, thin layer, piping.	Slope, depth to rock, large stones.	Slope, rooting depth, large stones.	Slope, depth to rock, large stones.	Slope, large stones, rooting depth.
[1]177:						
Rock outcrop part.						
Kidd part	Slope, depth to rock, seepage.	Thin layer, piping.	Complex slope, depth to rock.	Complex slope, droughty, rooting depth.	Complex slope, depth to rock, rooting depth.	Slope, rooting depth, droughty.
Sobrante:						
178, 179	Slope, depth to rock.	Shrink-swell, thin layer, low strength.	Complex slope, depth to rock.	Complex slope, rooting depth, erodes easily.	Complex slope, depth to rock, rooting depth.	Slope, rooting depth, erodes easily.
Tehama:						
180	Slope	Low strength, shrink-swell.	Slope, percs slowly.	Slope, percs slowly.	Slope, percs slowly	Slope, percs slowly.
Yolo:						
181	Favorable	Low strength, shrink-swell.	Favorable	Favorable	Favorable	Favorable.
182	Slope	Low strength, shrink-swell.	Slope	Slope	Slope	Slope.

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

that affect use are indicated for each kind of soil. This information is significant in planning, installing and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for this use have low seepage potential, which is determined by the permeability and depth over fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and is of favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes and levees.

Drainage of soil is affected by such soil properties as permeability, texture, depth to claypan or other layers that influence rate of water movement, depth to the water table, slope, stability of ditchbanks, susceptibility to flooding, salinity and alkalinity, and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments, or a combination of channels and ridges, constructed across a slope to intercept runoff and allow the water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity of slope and steepness, depth of bedrock or other unfavorable material, permeability, ease of establishing vegetation, and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff at nonerosive velocities to outlets. Features that affect the use of soils for waterways are slope, permeability, erodibility, and suitability for permanent vegetation.

Soil properties

Extensive data about soil properties collected during the soil survey are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of samples selected from representative soil profiles in the field.

When the soil scientists make soil borings during field mapping, they can identify several important soil properties. They note the seasonal soil moisture condition, or the presence of free water and its depth in the profile. For each horizon, they note the thickness of the soil and its color, the texture, or the amount of clay, silt, sand and gravel or other coarse fragments; the structure, or natural pattern of cracks and pores in the undisturbed soil; and the consistence of soil in place under the existing soil moisture conditions. They record the root depth of existing plants, determine soil pH or reaction, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to characterize key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many of the soil series are available from nearby areas.

Based on summaries of available field and laboratory data, and listed in tables in this section, are estimated ranges in engineering properties and classifications and in physical and chemical properties for each major horizon of each soil in the survey area. Also, pertinent soil and water features and engineering test data are presented.

Engineering properties

Table 10 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area. These estimates are presented as ranges in values most likely to exist in areas where the soil is mapped.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Information is presented for each of these contrasting horizons. Depth to the upper and lower boundaries of each horizon in a typical profile of each soil is indicated. More information about the range in depth and in properties of each horizon is given for each soil series in "Descriptions of the Soils."

Texture is described in table 10 in standard terms used by the United States Department of Agriculture (*13*). These terms are defined according to percentages of sand, silt and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms used by USDA are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified soil classification system and the American Association of State Highway and Transportation Officials soil classification system (AASHTO). In table 10, soils in the survey area are classified according to both systems.

The Unified system (*2*) 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, plasticity index, liquid limit, and organic matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example CL–ML.

The AASHTO system (*1*) classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified as one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size dis-

TABLE 10.—*Engineering properties and classifications*

[The symbol < means less than; > means greater than. NP means nonplastic. Absence of an entry means 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*	
Aiken:											
100, 101, 102	0–8	Loam	ML, CL-ML	A-4	0–5	95–100	80–100	70–80	60–70	25–35	5–10
	8–14	Clay loam	CL, ML	A-7, A-6	15–25	95–100	95–100	80–90	65–70	30–50	10–20
	14–44	Clay	MH	A-7	15–25	95–100	95–100	85–95	70–85	50–60	15–25
	44	Unweathered bedrock.									
Bale:											
103	0–24	Loam	SM, ML	A-4	0	85–100	80–100	60–95	45–75	20–40	NP–10
	24–60	Stratified loam to gravelly sandy loam.	SM	A-4	0	80–90	70–80	60–70	35–50	15–20	NP–5
104, 105	0–24	Clay loam	CL	A-6, A-7	0	80–100	80–100	70–100	70–80	30–50	10–25
	24–60	Stratified loam to gravelly sandy loam.	SM	A-4	0	80–90	70–80	60–70	35–50	15–20	NP–5
[1]106:											
Bale loam part.	0–24	Loam	SM, ML	A-4	0	95–100	80–100	60–95	45–75	20–40	NP–10
	24–60	Stratified loam to gravelly sandy loam.	SM	A-4	0	80–90	70–80	60–70	35–50	15–20	NP–5
Bale clay loam part.	0–24	Clay loam	CL	A-6, A-7	0	80–100	80–100	70–100	70–80	30–50	10–25
	24–60	Stratified loam to gravelly sandy loam.	SM	A-4	0	80–90	70–80	60–70	35–50	15–20	NP–5
Boomer:											
107	0–4	Loam	CL, CL-ML	A-4, A-6	0	90–100	90–100	80–90	50–80	20–40	5–15
	4–44	Clay loam, gravelly clay loam.	CL	A-6, A-7	0	90–100	65–90	55–85	50–85	30–50	10–25
	44	Weathered bedrock.									
108, 109	0–4	Gravelly loam	GM-GC, GC	A-4, A-6, A-2	0	55–75	50–70	45–70	20–50	20–40	5–15
	4–44	Clay loam, gravelly clay loam.	CL	A-6, A-7	0	90–100	65–90	55–85	50–85	30–50	10–25
	44	Weathered bedrock.									
[1]110, [1]111:											
Boomer part	0–4	Loam	CL, CL-ML	A-4, A-6	0	90–100	90–100	80–90	50–80	20–40	5–15
	4–44	Clay loam, gravelly clay loam.	CL	A-6, A-7	0	90–100	65–90	55–85	50–85	30–50	10–25
	44	Weathered bedrock.									
Forward part	0–4	Gravelly loam	SM, SM-SC	A-2, A-4	0	55–80	50–75	40–65	30–50	15–30	NP–10
	4–35	Loam, gravelly loam.	CL-ML, CL, SC, SM-SC	A-4, A-6	0	70–85	65–80	50–75	35–60	15–30	5–15
	35	Weathered bedrock.									
Felta part	0–7	Very gravelly loam.	GM, GM-GC	A-2	0	40–60	30–45	20–40	15–35	15–20	5–10
	7–26	Very gravelly clay loam.	GC, GM-GC	A-2, A-4, A-6	0	40–60	30–50	25–45	20–40	25–35	5–15
	26–60	Very gravelly sandy clay loam.	GC, GM-GC	A-2	0–10	40–60	25–45	20–35	15–30	20–30	5–15

See footnote at end of table.

TABLE 10.—*Engineering properties and classifications—Continued*

Soil name and map symbol	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Bressa: [1]112, [1]113, [1]114, [1]115:											
Bressa part	0–10	Silt loam	CL–ML, CL	A–4, A–6	0	85–100	85–100	60–95	50–70	25–35	5–15
	10–33	Clay loam, silty clay loam, gravelly clay loam.	GM, ML	A–6, A–7	0	65–100	65–100	55–100	40–85	35–50	10–20
	33	Weathered bedrock.									
Dibble part	0–9	Silty clay loam	CL, CL–ML	A–4	0	100	95–100	70–95	60–90	25–40	5–15
	9–34	Silty clay, clay	CH, CL	A–7	0	100	95–100	85–100	80–100	40–60	20–30
	34	Weathered bedrock.									
Clear Lake:											
116	0–32	Clay	CH	A–7	0	100	100	95–100	85–100	50–70	25–45
	32–69	Clay	CH	A–7	0	100	100	95–100	85–100	50–70	25–45
117	0–18	Fine sandy loam	SM	A–4, A–2	0	100	95–100	75–90	25–45	10–25	NP–5
	18–69	Clay	CL, CH	A–7	0	100	100	95–100	85–100	50–70	25–45
Cole:											
118, 119	0–8	Silt loam	CL–ML, ML	A–4, A–6, A–7	0	100	100	95–100	60–95	25–50	5–20
	8–64	Silty, clay loam, silty clay.	CL, CH	A–7	0	100	100	90–100	75–95	40–55	20–35
Contra Costa:											
120	0–5	Loam	CL	A–7, A–6	0	75–100	75–100	75–100	60–80	30–50	10–25
	5–22	Clay, clay loam	CL, CH	A–7	0	85–100	85–100	80–100	75–95	40–60	25–40
	22–34	Shaly clay, gravelly clay loam.	CL, CH	A–7	5	75–90	60–75	55–75	50–70	40–60	25–40
	34	Weathered bedrock.									
121	0–5	Gravelly loam	SC, CL	A–7	0	80–85	60–75	55–70	40–55	40–45	15–20
	5–34	Gravelly clay loam, gravelly clay.	SC, CL	A–7	0	80–85	60–75	60–70	45–60	45–50	15–20
	34	Weathered bedrock.									
Coombs:											
122, 123	0–4	Gravelly loam	GC, GM–GC, CL–ML, CL	A–4, A–6	0	60–75	60–80	55–60	45–55	20–40	5–15
	4–54	Gravelly clay loam, clay loam.	GC, CL	A–6	0	60–75	60–85	55–65	45–60	30–40	10–20
	54–60	Very gravelly loamy fine sand.	GP, GW	A–1	0	20–40	0–20	0–10	0–5		NP
Cortina.											
124	0–11	Very gravelly loam.	GM	A–2, A–1	0–10	20–50	30–50	20–40	15–30	15–25	NP–5
	11–60	Stratified very gravelly sandy loam to very gravelly loamy sand.	GP–GM	A–1	0–10	15–40	10–35	10–20	5–10		NP
125	0–21	Very stony loam	GM, SM	A–1	40–70	40–80	25–40	10–30	15–25		NP
	21–60	Very stony loam, stony loam, very cobbly loam.	GM, SM	A–1	40–70	35–85	20–40	15–35	10–25		NP
Diablo:											
126, 127, 128, 129.	0–60	Clay	CL, CH	A–7	0	100	95–100	95–100	85–100	45–75	20–40
	60	Weathered bedrock.									

See footnote at end of table.

TABLE 10.—*Engineering properties and classifications—Continued*

Soil name and map symbol	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Egbert:											
130	0–33	Silty clay loam	CL	A–7	0–5	100	95–100	90–100	80–95	40–45	15–20
	33–60	Clay, silty clay	CL, CH	A–7	0	100	95–100	95–100	85–100	45–75	20–40
Fagan:											
131, 132, 133 134.	0–16	Clay loam	CL	A–6, A–7	0	100	100	85–100	55–80	30–50	10–25
	16–28	Clay, silty clay, sandy clay.	CL, CH	A–6, A–7	0	100	100	95–100	50–95	35–55	15–35
	28–46	Sandy clay loam, clay loam.	CL, SC	A–6, A–7	0	100	100	85–100	45–80	30–45	15–25
	46	Weathered bedrock.									
Felton:											
135, 136, 137	0–10	Gravelly loam	GM–GC, GC	A–2, A–4, A–6	0	55–75	50–65	45–60	30–50	20–35	5–15
	10–33	Clay loam	CL	A–6	0	85–100	80–100	75–95	70–85	25–40	10–25
	33	Weathered bedrock.									
Forward:											
138, 139, 140	0–4	Gravelly loam	SM, SM–SC	A–2, A–4	0	55–80	50–75	40–65	30–50	15–30	NP–10
	4–35	Loam, gravelly loam.	CL–ML, CL, SC, SM–SC	A–6, A–4	0	70–85	65–80	50–75	35–60	15–30	5–15
	35	Weathered bedrock.									
[1]141:											
Forward part	0–4	Gravelly loam	SM, SM–SC	A–2, A–4	0	55–80	50–75	40–65	30–50	15–30	NP–10
	4–35	Loam, gravelly Loam.	CL–ML, CL, SC, SM–SC	A–6, A–4	0	70–85	65–80	50–75	35–60	15–30	5–15
	35	Weathered bedrock.									
Kidd part	0–14	Loam	CL, CL–ML, SC, SM–SC	A–4, A–6	0–5	75–90	70–85	50–75	35–60	20–30	5–15
	14	Unweathered bedrock.									
Guenoc:											
142	0–12	Laom	CL	A–6	0	80–100	75–100	70–95	50–75	30–40	5–10
	12–30	Clay loam, silty clay loam, gravelly clay loam.	GC, CL	A–6, A–7	15–30	60–100	55–95	50–85	40–85	35–50	15–35
	30	Weathered bedrock.									
[1]143, [1]144:											
Guenoc part	0–12	Loam	CL	A–6	0	80–100	75–100	70–95	50–75	30–40	5–10
	12–30	Clay loam, silty clay loam, gravelly clay loam.	GC, CL	A–6, A–7	15–30	60–100	55–95	50–85	40–85	35–50	15–35
	30	Weathered bedrock.									
Rock outcrop part.											

See footnote at end of table.

TABLE 10.—*Engineering properties and classifications—Continued*

Soil name and map symbol	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Haire:											
145, 146	0–22	Loam	CL	A–6	0	85–100	80–100	70–90	50–70	30–40	10–20
	22–27	Sandy clay loam	SC	A–6	0	100	100	80–90	35–50	25–35	10–20
	27–45	Clay	CL, CH	A–7	0	100	90–100	85–100	70–95	40–60	20–30
	45–60	Sandy clay	CH, CL, SC	A–6, A–7	0	100	100	85–95	45–60	35–55	20–40
147, 148, 149, 150	0–22	Clay loam	CL	A–7	0	85–100	80–100	70–90	50–70	40–50	20–30
	22–27	Sandy clay loam	SC	A–6	0	100	100	80–90	35–50	25–35	10–20
	27–45	Clay	CL, CH	A–7	0	100	90–100	85–100	70–95	40–60	20–30
	45–60	Sandy clay	CH, CL, SC	A–6, A–7	0	100	100	85–95	45–60	35–55	20–40
Hambright:											
[1]151, [1]152:											
Hambright part.	0–12	Very stony loam	CL–ML, CL	A–4, A–6	50–75	90–100	85–100	75–95	55–90	15–30	5–15
	12	Unweathered bedrock.									
Rock outcrop part.											
Henneke:											
153, 154	0–7	Gravelly loam	GM-GC, GC, CL–ML, CL	A–6, A–4, A–7	0–30	55–95	50–85	45–80	35–75	25–35	5–15
	7–15	Very gravelly clay loam, very gravelly clay.	SC, GC	A–2, A–6, A–7	0–30	50–80	30–75	40–70	30–50	35–60	15–35
	15	Unweathered bedrock.									
Kidd:											
155, 156	0–14	Loam	CL, CL–ML, SC, SM–SC	A–4, A–6	0–5	75–90	70–85	50–75	35–60	20–30	5–15
	14	Unweathered bedrock.									
Lodo:											
[1]157:											
Lodo part	0–7	Loam	CL	A–6	0–5	90–100	85–100	70–95	60–80	25–35	10–20
	7	Unweathered bedrock.									
Maymen part.	0–12	Gravelly loam	GM, ML	A–4, A–2	0–5	60–80	50–75	40–65	30–60	10–20	NP–5
	12	Unweathered bedrock.									
Felton part	0–10	Gravelly loam	GM–GC, GC	A–2, A–4, A–6	0	55–75	50–65	45–60	30–50	20–35	5–15
	10–33	Clay loam	CL	A–6	0	85–100	80–100	75–95	70–85	20–40	10–25
	33	Weathered bedrock.									
Los Gatos:											
158, 159, 160	0–25	Loam	CL	A–6	0–5	90–100	80–95	75–85	60–75	25–40	10–20
	25–36	Clay loam, gravelly clay loam.	CL	A–6	0–5	75–100	70–95	60–80	50–65	30–40	15–25
	36	Unweathered bedrock.									
Maxwell:											
161	0–62	Clay	CL, CH	A–7	0	100	100	90–100	70–95	40–60	25–40
Maymen:											
[1]162:											
Maymen part.	0–12	Gravelly loam	GM, ML	A–4, A–2	0–5	60–80	50–75	40–65	30–60	15–25	NP–5
	12	Unweathered bedrock.									

See footnote at end of table.

TABLE 10.—*Engineering properties and classifications—Continued*

Soil name and map symbol	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Maymen:											
[1]162											
Los Gatos part	0–25	Loam	CL	A–6	0–5	90–100	80–95	75–85	60–75	25–40	10–20
	25–36	Clay loam, gravelly clay loam.	CL	A–6	0–5	75–100	70–95	60–80	50–65	30–40	15–25
	36	Unweathered bedrock.									
[1]163:											
Maymen part.	0–12	Gravelly loam	GM, ML	A–4, A–2	0–5	60–80	50–75	40–65	30–60	10–20	NP–5
	12	Unweathered bedrock.									
Millsholm part.	0–12	Loam	ML, CL–ML	A–4	0	80–100	80–100	70–100	50–70	20–35	5–10
	12	Unweathered bedrock.									
Lodo part	0–7	Loam	CL	A–6	0–5	90–100	85–100	70–95	60–80	25–35	10–20
	7	Unweathered bedrock.									
Millsholm:											
164, 165	0–12	Loam	ML, CL–ML	A–4	0	80–100	80–100	70–100	50–70	20–35	5–10
	12	Unweathered bedrock.									
Montara:											
166, 167	0–12	Clay loam	CL	A–6, A–7	0–5	90–100	75–100	75–90	70–80	30–50	10–25
	12	Unweathered bedrock.									
Perkins:											
168, 169	0–29	Gravelly loam	GM–GC, SM–SC	A–2, A–4	0	60–85	55–70	35–65	20–50	25–30	5–10
	29–60	Gravelly clay loam, gravelly loam.	SC, CL	A–6, A–7	0	60–85	50–70	45–70	35–60	35–50	15–25
Pleasanton:											
170, 171	0–11	Loam	ML	A–4	0–15	80–100	75–100	65–85	50–75	25–35	NP–10
	11–66	Loam, clay loam, sandy clay loam.	CL	A–6	0–10	80–100	75–100	65–85	35–75	30–40	10–20
Reyes:											
172, 173	0–14	Silty clay loam	CL, OL	A–6, A–7	0	100	100	95–100	80–95	35–50	10–25
	14–60	Silty clay loam, silty clay.	MH, CH	A–7	0	100	100	95–100	85–100	50–70	20–40
Riverwash:											
174	0–60	Variable.									
Rock outcrop:											
175.											
[1]176:											
Rock outcrop part.											
Hambright part.	0–12	Very stony loam	CL–ML, CL	A–4, A–6	50–75	90–100	85–100	75–95	55–90	15–30	5–15
	12	Unweathered bedrock.									
[1]177:											
Rock outcrop part.											
Kidd part	0–14	Loam	CL, CL–ML, SC, SM–SC	A–4, A–6	0–5	75–90	70–85	50–75	35–60	20–30	5–15
	14	Unweathered bedrock.									

See footnote at end of table.

TABLE 10.—*Engineering properties and classifications—Continued*

Soil name and map symbol	Depth	USDA texture	Classification		Fragments >3 inches	Percentage passing sieve number—				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				*Pct*					*Pct*	
Sobrante:											
178, 179	0–6	Loam	ML	A–4	0	95–100	75–90	70–85	55–70	25–35	NP–10
	6–30	Loam, clay loam, silty clay loam.	CL	A–6	0–5	95–100	75–90	70–90	55–80	30–40	10–20
	30	Unweathered bedrock.									
Tehama:											
180	0–12	Silt loam	ML	A–4, A–6	0	95–100	95–100	90–100	75–95	30–40	5–15
	12–60	Silty clay loam, clay loam.	CL	A–6, A–7	0	95–100	95–100	90–100	80–95	30–45	10–20
Yolo:											
181, 182	0–6	Loam	CL–ML	A–4	0	100	100	90–95	60–80	20–35	5–10
	6–60	Silt loam, silty clay loam.	CL	A–6	0	100	100	95–100	80–95	30–40	10–20

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

tribution, liquid limit, and plasticity index. Soils in group A–1 are coarse grained and low in content of fines. At the other extreme, in group A–7, are fine-grained soils. Highly organic soils are classified as A–8 on the basis of visual inspection.

When laboratory data are available, the A–1, A–2, and A–7 groups are further classified as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or more for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 13. The estimated classification, without group index numbers, is given in table 10. Also in table 10 the percentage, by weight, of cobbles or the rock fragments more than 3 inches in diameter are estimated for each major horizon. These estimates are determined largely by observing volume percentage in the field and then converting it, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four standard sieves is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and plasticity index indicate the effect of water on the strength and consistency of soil. These indexes are used in both the Unified and the AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior.

Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

All of the estimates have been rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted in table 10.

Physical and chemical properties

Table 11 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the representative profile of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships between the soil characteristics observed in the field—particularly soil structure, porosity and gradation or texture—that influence the downward movement of water in the soil. The estimates are for water movement in a vertical direction when the soil is saturated. Not considered in the estimates are lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in the planning and design of drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH value. The range in pH of each major horizon is based on many field checks. For many soils, the values have been

TABLE 11.—*Physical and chemical*

[The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in of soil*	*pH*
Aiken:				
100, 101, 102	0–8	0.6–2.0	0.13–0.17	5.1–6.5
	8–14	0.2–0.6	0.15–0.17	5.1–6.0
	14–44	0.2–0.6	0.17–0.19	5.1–6.0
	44			
Bale:				
103	0.24	0.6–2.0	0.13–0.16	5.5–6.5
	24.60	0.6–2.0	0.08–0.11	5.5–6.5
104, 105	0–24	0.6–2.0	0.14–0.16	5.5–6.5
	24–60	0.6–2.0	0.08–0.11	5.5–6.5
[1] 106:				
Bale loam part	0–24	0.6–2.0	0.13–0.15	6.6–8.4
	24–60	0.6–2.0	0.08–0.11	6.6–8.4
Bale clay loam part	0–24	0.6–2.0	0.13–0.15	6.6–8.4
	24–60	0.6–6.0	0.08–0.11	6.6–8.4
Boomer:				
107	0–4	0.6–2.0	0.14–0.18	5.6–6.5
	4–44	0.2–0.6	0.13–0.20	6.1–6.5
	44			
108, 109	0–4	0.6–2.0	0.12–0.16	6.1–6.5
	4–44	0.2–0.6	0.13–0.20	6.1–6.5
	44			
[1] 110, [1] 111:				
Boomer part	0–4	0.6–2.0	0.14–0.18	5.6–6.5
	4–44	0.2–0.6	0.13–0.20	6.1–6.5
	44			
Forward part	0–4	2.0–6.0	0.06–0.12	5.5–6.5
	4–35	2.0–6.0	0.06–0.12	5.1–6.0
	35			
Felta part	0–7	2.0–6.0	0.05–0.07	6.1–7.3
	7–26	0.6–2.0	0.05–0.07	5.6–6.5
	26–60	0.6–2.0	0.06–0.09	5.1–6.0
Bressa:				
[1] 112, [1] 113, [1] 114, [1] 115:				
Bressa part	0–10	0.6–2.0	0.14–0.17	6.1–7.3
	10–33	0.2–0.6	0.12–0.20	5.6–7.3
	33			
Dibble part	0–9	0.6–2.0	0.14–0.20	5.6–6.5
	9–34	0.06–0.2	0.14–0.18	6.1–7.3
	34			
Clear Lake:				
116	0–32	0.06–0.2	0.13–0.17	6.1–7.9
	32–69	0.06–0.2	0.13–0.17	7.4–8.4
117	0–18	2.0–6.0	0.14–0.15	6.1–7.9
	18–69	0.06–0.2	0.13–0.18	7.4–8.4
Cole:				
118, 119	0–8	0.6–2.0	0.16–0.21	6.1–7.3
	8–64	0.2–0.6	0.16–0.20	7.4–8.4
Contra Costa:				
120	0–5	0.6–2.0	0.18–0.20	6.1–7.3
	5–22	0.06–0.2	0.19–0.21	6.1–7.3
	22–34	0.06–0.2	0.17–0.19	6.1–7.3
	34			
121	0–5	0.06–0.6	0.15–0.18	6.1–7.3
	5–34	0.06–0.6	0.16–0.19	6.1–7.3
	34			
Coombs:				
122, 123	0–14	0.6–2.0	0.14–0.20	5.1–6.0
	4–54	0.2–0.6	0.14–0.20	5.1–6.0
	54–60	>6.0	0.03–0.05	5.6–6.0
Cortina:				
124	0–11	2.0–6.0	0.09–0.13	6.1–7.8
	11–60	6.0–20	0.06–0.09	6.1–7.8
125	0–21	2.0–6.0	0.03–0.07	6.1–7.8
	21–60	6.0–20	0.03–0.07	6.1–8.4
Diablo:				
126, 127, 128, 129	0–60	0.06–0.2	0.14–0.17	6.1–8.4
	60			

See footnote at end of table.

properties of soils

the entire profile. Absence of an entry means data were not available or were not estimated]

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<2	Low	High	Moderate	0.28	5
<2	Moderate	High	Moderate	0.28	
<2	Moderate	High	Moderate	0.24	
<2	Low	High	Moderate	0.24	4
<2	Low	High	Moderate	0.17	
<2	Moderate	High	Moderate	0.20	4
<2	Low	High	Moderate	0.17	
>8	Low	High	Low	0.24	4
<8	Low	High	Low	0.17	
>8	Moderate	High	Low	0.20	4
<8	Low	High	Low	0.17	
<2	Low	Moderate	Moderate	0.28	5
<2	Moderate	Moderate	Moderate	0.28	
<2	Low	Moderate	Moderate	0.28	5
<2	Moderate	Moderate	Moderate	0.28	
<2	Low	Moderate	Moderate	0.28	5
<2	Moderate	Moderate	Moderate	0.28	
<2	Low	Moderate	High	0.17	2
<2	Low	Moderate	High	0.17	
<2	Low	Moderate	Low	0.24	4
<2	Low	Moderate	Moderate	0.20	
<2	Low	Moderate	Moderate	0.20	
<2	Low	Moderate	Moderate	0.37	2
<2	Moderate	Moderate	Moderate	0.24	
<2	Moderate	Moderate	Moderate	0.55	2
<2	High	High	Moderate	0.32	
<2	High	High	High	0.24	5
<2	High	High	High	0.24	
<2	Low	High	Low	0.32	5
<2	High	High	Moderate	0.24	
<2	Moderate	Moderate	Low	0.37	5
<2	High	High	Low	0.28	
<2	Moderate	Moderate	Low	0.24	3
<2	High	High	Low	0.24	
<2	High	High	Low	0.24	
<2	Moderate	Moderate	Low	0.20	3
<2	Moderate	Moderate	Low	0.20	
<2	Moderate	Moderate	Moderate	0.24	4
<2	Moderate	Moderate	Moderate	0.28	
<2	Low	Moderate	Moderate	0.10	
<2	Low	Moderate	Low	0.20	5
<2	Low	Moderate	Low	0.15	
<2	Low	Moderate	Low	0.15	5
<2	Low	Moderate	Low	0.15	
<2	High	High	Low	0.24	3

TABLE 11.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in of soil*	*pH*
Egbert:				
130	0–33	0.06–0.2	0.14–0.20	6.6–8.4
	33–60	0.06–0.2	0.14–0.20	6.6–8.4
Fagan:				
131, 132, 133, 134	0–16	0.2–0.6	0.14–0.20	5.6–6.5
	16–28	0.06–0.2	0.14–0.20	5.6–6.5
	28–46	0.2–0.6	0.14–0.20	5.6–6.5
	46			
Felton:				
135, 136, 137	0–10	0.6–2.0	0.16–0.21	6.1–7.3
	10–33	0.2–0.6	0.18–0.21	5.6–7.3
	33			
Forward:				
138, 139, 140	0–4	2.0–6.0	0.06–0.12	5.5–6.5
	4–35	2.0–6.0	0.06–0.12	5.1–6.0
	35			
[1] 141:				
Forward part	0–4	2.0–6.0	0.06–0.12	5.5–6.5
	4–35	2.0–6.0	0.06–0.12	5.1–6.0
	35			
Kidd part	0–14	2.0–6.0	0.10–0.19	5.6–6.5
	14			
Guenoc:				
142	0–12	0.6–2.0	0.16–0.18	6.1–7.3
	12–30	0.2–0.6	0.14–0.16	5.6–6.6
	30			
[1] 143, [1] 144:				
Guenoc part	0–12	0.6–2.0	0.16–0.18	6.1–7.3
	12–30	0.2–0.6	0.14–0.16	5.6–6.6
	30			
Rock outcrop part.				
Haire:				
145, 146, 147, 148, 149, 150	0–22	0.2–0.6	0.15–0.20	5.1–6.0
	22–27	0.2–0.6	0.15–0.20	5.1–6.0
	27–45	<0.06	0.04–0.06	4.5–5.5
	45–60	<0.06	0.04–0.06	4.5–5.5
Hambright:				
[1] 151, [1] 152:				
Hambright part	0–12	0.6–2.0	0.08–0.10	5.6–6.5
	12			
Rock outcrop part.				
Henneke:				
153, 154	0–7	0.6–2.0	0.10–0.20	6.1–7.3
	7–15	0.2–0.6	0.10–0.20	6.6–8.4
	15			
Kidd:				
155, 156	0–14	2.0–6.0	0.10–0.19	5.6–6.5
	14			
Lodo:				
[1] 157:				
Lodo part	0–7	0.6–2.0	0.14–0.18	6.1–7.3
	7			
Maymen part	0–12	0.6–2.0	0.10–0.12	5.1–6.5
	12			
Felton part	0–10	0.6–2.0	0.16–0.21	5.6–7.3
	10–33	0.2–0.6	0.18–0.21	5.1–7.3
	33			
Los Gatos:				
158, 159, 160	0–25	0.6–2.0	0.15–0.20	6.1–7.3
	25–36	0.2–0.6	0.14–0.20	5.6–7.3
	36			
Maxwell:				
161	0–62	<0.06	0.17–0.20	6.6–8.4
Maymen:				
[1] 162:				
Maymen part	0–12	0.6–2.0	0.10–0.12	5.1–6.5
	12			
Los Gatos part	0–25	0.6–2.0	0.15–0.20	6.1–7.3
	25–36	0.2–0.6	0.14–0.20	5.6–7.3
	36			

See footnote at end of table.

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<4	Moderate	High	Moderate	0.37	5
<4	High	High	Moderate	0.24	
<2	Moderate	Moderate	Moderate	0.28	3
<2	High	Moderate	Moderate	0.28	
<2	Moderate	Moderate	Moderate	0.28	
<2	Moderate	Moderate	Moderate	0.37	2
<2	Moderate	Moderate	High	0.28	
<2	Low	Moderate	High	0.17	2
<2	Low	Moderate	High	0.17	
<2	Low	Moderate	High	0.17	2
<2	Low	Moderate	High	0.17	
<2	Low	Moderate	Moderate		2
<2	Low	Moderate	Low	0.37	2
<2	Moderate	Moderate	Moderate	0.20	
<2	Low	Moderate	Low	0.37	2
<2	Moderate	Moderate	Moderate	0.20	
<2	Moderate	Moderate	Moderate	0.32	2
<2	Moderate	Moderate	Moderate	0.24	
<2	High	High	Moderate	0.20	
<2	High	High	Moderate	0.20	
<2	Low	Moderate	Low	0.28	1
<2	Low	High	Moderate	0.24	1
<2	Moderate	High	Low	0.24	
<2	Low	Moderate	Moderate		1
<2	Moderate	Moderate	Low	0.28	1
<2	Low	Moderate	Moderate	0.15	1
<2	Moderate	High	Moderate	0.37	2
<2	Moderate	High	High	0.28	
<2	Moderate	Moderate	Moderate	0.32	2
<2	Moderate	Moderate	Moderate	0.37	
<2	High	High	Low	0.32	5
<2	Low	Moderate	Moderate	0.15	1
<2	Moderate	Moderate	Moderate	0.32	2
<2	Moderate	Moderate	Moderate	0.37	

TABLE 11.—*Physical and chemical*

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction
	In	*In/hr*	*In/in of soil*	*pH*
Maymen:				
[1] 163:				
Maymen part	0–12	0.6–2.0	0.10–0.18	5.1–6.5
	12			
Millsholm part	0–12	0.6–2.0	0.16–0.19	5.6–6.5
	12			
Lodo part	0–7	0.6–2.0	0.14–0.18	6.1–7.3
	7			
Millsholm:				
164, 165	0–12	0.6–2.0	0.16–0.19	5.6–6.5
	12			
Montara:				
166, 167	0–12	0.2–0.6	0.17–0.20	6.6–8.4
	12			
Perkins:				
168, 169	0–29	0.6–2.0	0.07–0.12	6.1–7.3
	29–60	0.06–0.2	0.10–0.13	6.1–7.3
Pleasanton:				
170, 171	0–11	0.6–2.0	0.13–0.15	5.5–6.5
	11–66	0.2–0.6	0.13–0.15	5.5–6.5
Reyes:				
172	0–14	0.06–0.2	0.13–0.20	<5.0
	14–60	0.06–0.2	0.13–0.20	<5.0
173	0–14	0.06–0.2	0.13–0.20	7.4–8.4
	14–60	0.06–0.2	0.13–0.20	4.5–8.4
Rock outcrop:				
175.				
[1] 176:				
Rock outcrop part.				
Hambright part	0–12	0.6–2.0	0.08–0.10	5.6–6.5
	12			
[1] 177:				
Rock outcrop part.				
Kidd part	0–14	2.0–6.0	0.10–0.19	5.6–6.5
	14			
Sobrante:				
178, 179	0–6	0.6–2.0	0.13–0.18	5.6–6.5
	6–30	0.6–2.0	0.13–0.19	5.6–6.5
	30			
Tehama:				
180	0–12	0.6–2.0	0.16–0.20	5.6–6.5
	12–60	0.06–0.2	0.17–0.20	6.6–7.8
Yolo:				
181, 182	0–6	0.6–2.0	0.16–0.18	6.1–7.3
	6–60	0.6–2.0	0.17–0.20	6.1–7.9

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of

verified by laboratory analyses. Soil reaction is important in selecting the crops and ornamental or other plants to be grown, in evaluating soil amendments for fertility and stabilization, and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is largely affected by the quality of the irrigation water and the irrigation practices. Hence, the salinity of individual fields can differ greatly from the value given in table 11. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-well potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others it was estimated on the basis of the kind of clay and on measurements of similar soils. Size of imposed loadings and the magnitude of changes in soil moisture content are also important factors that influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basements, walls, roads, and other structures unless special designs are used. A *high* shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion, as used in table 11, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical

properties of soils—Continued

Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors	
		Uncoated steel	Concrete	K	T
Mmhos/cm					
<2	Low	Moderate	Moderate	0.15	1
<2	Low	Moderate	Moderate	0.43	1
<2	Moderate	Moderate	Low	0.28	1
<2	Low	Moderate	Moderate	0.43	1
<2	Moderate	High	Low	0.32	1
<2	Low	Moderate	Low	0.28	5
<2	Moderate	Moderate	Low	0.20	
<2	Low	Moderate	Moderate	0.32	5
<2	Moderate	Moderate	Moderate	0.32	
>4	Moderate	High	High	0.20	5
>4	Moderate	High	High	0.20	
>16	Moderate	High	High	0.20	5
>4	High	High	High	0.20	
<2	Low	Moderate	Low	0.28	1
<2	Low	Moderate	Moderate		1
<2	Low	Moderate	Moderate	0.49	2
<2	Moderate	Moderate	Moderate	0.37	
<2	Low	Moderate	Moderate	0.43	3
<2	Moderate	Moderate	Moderate	0.37	
<2	Low	Moderate	Low	0.37	5
<2	Moderate	Moderate	Low	0.37	

the whole mapping unit.

conductivity of the soil material. The rating of soils for corrosivity to concrete is based mainly on the sulfate content, soil texture, and acidity. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Installations of steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely within one kind of soil or within one soil horizon.

The soil erodibility factor (K) is used in the universal soil loss equation, and is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff (*18*). It is a value determined experimentally for selected benchmark soils. Based on a knowledge of the behavior of soil properties and their interactions these data are synthesized and values assigned to other kinds of soil.

Soil-loss tolerance (T), sometimes called permissible soil loss, is the maximum rate of soil erosion (whether from rainfall or wind) that will permit a high level of crop productivity to be sustained economically and indefinitely. It can also be used to determine the permissible soil loss in construction areas.

Soil-loss tolerance is related to soil depth and the ability of the soil to replace the soil lost.

Soil and water features

Features that relate to runoff or infiltration of water, to flooding, to grading and excavation and to subsidence and frost action of each soil are indicated in table 12. This information is helpful in planning land uses and engineering projects that are likely to be affected by the amount of runoff from watersheds, by flooding and a seasonal high water table, by the pres-

TABLE 12.—*Soil and water features*

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "rare" and "brief." The symbol > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			*In*	
Aiken:									
100, 101, 102	B	None			>6.0			40-60	Hard
Bale:									
103, 104, 105	C	Rare			>4.0	Apparent	Nov-Mar	>60	
[1]106:									
Bale loam part	C	Rare			2.0-4.0	Apparent	Nov-Mar	>60	
Bale clay loam part.	C	Rare			2.0-4.0	Apparent	Nov-Mar	>60	
Boomer:									
107, 108, 109	B	None			>6.0			40-60	Rippable
[1]110, [1]111:									
Boomer part	B	None			>6.0			40-60	Rippable
Forward part	C	None			>6.0			20-40	Rippable
Felta part	B	None			>6.0			>60	
Bressa:									
[1]112, [1]113, [1]114, [1]115:									
Bressa part	C	None			>6.0			30-40	Rippable
Dibble part	C	None			>6.0			20-40	Rippable
Clear Lake:									
116	D	None			>6.0			>60	
117	D	Frequent	Brief	Nov-Mar	3.0-6.0	Apparent	Dec-Mar	>60	
Cole:									
118, 119	C	None			3.0-5.0	Apparent	Feb-Apr	>60	
Contra Costa:									
120, 121	C	None			>6.0			25-40	Rippable
Coombs:									
122, 123	B	None			>6.0			>60	
Cortina:									
124, 125	A	None			>6.0			>60	
Diablo:									
126, 127, 128, 129	D	None			>6.0			40-80	Rippable
Egbert:									
130	C	Occasional	Very long	Jan-Dec	0.5-3.0	Apparent	Jan-Dec	>60	
Fagan									
131, 132, 133, 134	C	None			>6.0			40-60	Rippable
Felton:									
135, 136, 137	C	None			>6.0			30-40	Rippable
Forward:									
138, 139, 140	C	None			>6.0			20-40	Rippable
[1]141:									
Forward part	C	None			>6.0			20-40	Rippable
Kidd part	D	None			>6.0			12-15	Rippable
Guenoc:									
142	C	None			>6.0			25-40	Rippable
[1]143, [1]144:									
Guenoc part	C	None			>6.0			25-40	Rippable
Rock outcrop part.									
Haire:									
145, 146, 147, 148, 149, 150	C	None			>6.0			>60	
Hambright:									
[1]151, [1]152:									
Hambright part	D	None			>6.0			10-20	Hard
Rock outcrop part.									
Henneke:									
153, 154	D	None			>6.0			10-20	Hard
Kidd:									
155, 156	D	None			>6.0			12-15	Rippable
Lodo:									
[1]157:									
Lodo part	D	None			>6.0			6-20	Rippable
Maymen part	D	None			>6.0			10-16	Hard
Felton part	C	None			>6.0			30-40	Rippable
Los Gatos:									
158, 159, 160	C	None			>6.0			20-40	Hard

See footnote at end of table.

TABLE 12.—*Soil and water features—Continued*

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			*In*	
Maxwell:									
161	D	None			>6.0			>60	
Maymen:									
[1]162:									
Maymen part	D	None			>6.0			10–16	Hard
Los Gatos part	C	None			>6.0			20–40	Hard
[1]163:									
Maymen part	D	None			>6.0			10–16	Hard
Millsholm part	D	None			>6.0			12–20	Hard
Lodo part	D	None			>6.0			6–20	Rippable
Millsholm:									
164, 165	D	None			>6.0			10–20	Hard
Montara:									
166, 167	D	None			>6.0			10–15	Hard
Perkins:									
168, 169	C	None			>6.0			>60	
Pleasanton:									
170, 171	B	None			>6.0			>60	
Reyes:									
172	C/D	Frequent	Very brief	Jan-Dec	0–2.0	Apparent	Oct–May	>60	
173	D	Frequent	Very long	Jan-Dec	0–1.0	Apparent	Jan-Dec	>60	
Riverwash:									
174	D	Frequent	Very long	Jan-Dec	0–3.0	Apparent	Jan-Dec	>60	
Rock outcrop:									
175.									
[1]176:									
Rock outcrop part.									
Hambright part	D	None			>6.0			10–20	Hard
[1]177:									
Rock outcrop part.									
Kidd part	D	None			>6.0			12–15	Rippable
Sobrante:									
178, 179	C	None			>6.0			25–40	Hard
Tehama:									
180	C	None			>6.0			>60	
Yolo:									
181, 182	B	None			>6.0			>60	

[1] This mapping unit is made up of two or more dominant kinds of soil. See mapping unit description for the composition and behavior of the whole mapping unit.

ence of bedrock or a cemented pan in the upper 5 or 6 feet of the soil, by subsidence, or by frost action.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 to deep, moderately well drained to 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 that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is rated in general terms that describe the frequency, duration, and period of the year when flooding is most likely. The ratings are based on evidences in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; absence of distinctive soil horizons that form in soils of the area that are not subject to flooding; local information about flood-

water heights and the extent of flooding; and local knowledge that relates the unique landscape position of each soil to historic floods.

The generalized description of flood hazards is of value in land use planning and provides a valid basis for land use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

A seasonal high water table is the highest level of a saturated zone more than 6 inches thick in soils for continuous periods of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed during the course of the soil survey. Indicated are the depth to the seasonal high water table; the kind of water table, whether perched, artesian, or the upper part of the ground water table; and the months of the year that the high water commonly is present. Only those saturated zones above a depth of 5 to 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed fountains, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not to construct basements and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at depths of 5 to 6 feet or less. For many soils, limited ranges in depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and other observations during the soil mapping. The kind of bedrock and its relative hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200 horsepower tractor, but hard bedrock generally requires blasting.

Engineering test data

Table 13 gives test data for samples collected from selected soils and tested by the California Division of Highways (*6*). The data in the table shows the moisture density, the mechanical analysis, liquid limit, and plasticity index. Also shown is the classification of the samples under the American Association of State Highway and Transportation Officials (AASHTO) system (*1*) and the Unified system (*2*).

In the moisture-density, or compaction, test, a sample of the soil material is compacted several times using the same compactive effort, but each time at a higher content of moisture. The dry density, or weight unit, of the compacted material increases until the optimum moisture content is reached. After that, the density decreases with increase in the moisture content. The highest dry density obtained is termed "maximum dry density," and the corresponding moisture-content is termed "optimum moisture." Moisture-density data are important in construction, for as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

The mechanical analysis was determined by sieve and hydrometer method. The data show the percentage of soil particles that would pass sieves of specified sizes. The amount of clay fraction was determined by

TABLE 13.—*Engineering*

[Tests performed by California Division of Highways in accordance with procedures

Soil name and location	Report No.	Depth	Horizon	Moisture density [1]	
				Maximum dry density	Optimum moisture content
		In		*Lb/cu ft*	*Pct*
Bale gravelly loam:	1409	0–6	Ap	103	16
NE¼NE¼ section 6, T. 8 N., R. 6 W.	1410	6–17	B21	105	15
	1411	0–4	Ap	116	14
Coombs loam:	1412	35–43	B22t	123	12
NW¼NW¼ section 27, T. 6 N., R. 4 W.	1406	0–4	A1	107	17
Forward gravelly loam:	1407	13–22	B21	110	16
SW¼SW¼ section 8, T. 9 N., R. 5 W.	1408	22–32	B22	108	16
	1404	0–10	A11		
Maxwell clay:	1405	38–48	C1	105	14
700 ft. W., 250 ft. S. of center of section 14, T. 9 N., R. 5 W.					

[1] Based on tests of relative compaction of untreated and treated soils and aggregates, method No. Calif. 216 E.
[2] Mechanical analyses by California Division of Highways.

the hydrometer method. Sand and coarser particles do not pass the No. 200 sieve, but silt and clay do.

The tests of liquid limit and plasticity index measure the effect of water on the strength and consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a semi-solid to a plastic state. The *liquid limit* is the moisture content at which a soil passes from a plastic to liquid state. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition. When the plastic limit is equal to or higher than the liquid limit, the plasticity index is reported as nonplastic (NP).

Formation, morphology, and classification of the soils

In this section the major factors that affect the formation of soils in Napa County are discussed and important processes in the morphology of the soils are described. The system of classification is explained.

Formation of the soils

The interaction of five soil-forming factors—climate, plants and animals, relief or topography, parent material, and time—determines the characteristics of a soil at any given point. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The relative effect of an individual factor varies from one soil to another.

Climate and plants and animals are the active forces of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into soil. Relief modifies the effects of climate and vegetation, mainly by its influence on runoff and temperature. The nature of the parent material also affects the kind of soil that is formed. Time is needed for changing the parent material into soil. Generally, a long time is needed for distinct soil horizons to form.

The interactions among these factors are more complex for some soils than for others.

In the pages that follow, the five major factors of soil formation are discussed in relation to their effects on the soils of Napa County.

Climate

The climate, mainly temperature and precipitation, has a marked influence on the kind of soil that forms. Temperature and moisture greatly influence the amount and kind of vegetation, the rate of organic matter decomposition, the rate that minerals weather, and the degree of removal or accumulation of material in the different soil horizons.

The transition between the climatic regions in the county is gradual. The mean annual temperature varies a few degrees from one region to another, but the difference between the maximum and minimum temperature varies greatly. In Napa Valley the average annual temperature is about 57.5° F. near Napa and about 58.5° F. at Calistoga. The higher average temperature at Calistoga is partly the result of a thinner fog cover in summer. Elevation ranges from 21 feet at Napa to 383 feet at Calistoga. In the mountainous parts of the area, average annual temperatures

test data

given in California Materials Manual for Testing and Control Procedures]

Mechanical analysis [2]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—						AASHTO [3]	Unified
No. 4	No. 10	No. 40	No. 200	0.05 mm	0.02 mm	0.005 mm	0.002 mm				
								Pct			
89	83	74	53	50	37	23	13	33	2	A-4 (3)	ML
93	85	70	51	48	38	24	16	34	7	A-4 (4)	ML
97	93	80	61	58	41	24	16	27	4	A-4 (4)	ML
98	93	77	57	55	41	25	18	23	4	A-4 (3)	CL-ML
80	60	50	42	39	34	18	8	32	2	A-4 (2)	SM
80	68	55	45	44	38	22	10	28	1	A-4 (1)	SM
84	72	60	48	47	44	24	12	--------	[4] NP	A-4 (0)	SM
100	99	98	95	94	82	66	54	69	38	A-7-5 (44)	CH
100	99	98	95	94	82	70	59	72	41	A-7-5 (47)	CH

[3] Based on AASHTO Designation M 145-49 (*1*).
[4] NP—Nonplastic.

decrease as elevation increases. The average annual temperature at Angwin is 56.8° F.

Napa County has warm, dry summers and cool, moist winters. Most of the rainfall occurs from November through April. Annual rainfall ranges from 20 inches near Vallejo to 60 inches near Mount St. Helena. On the higher ridges, some of the precipitation in winter is in the form of snow.

Soil-forming processes in the county are cyclic. Weathering is relatively rapid in spring and early summer and slow in fall. Little weathering occurs in winter. Warm temperatures in spring, while the soils are moist, are favorable for rapid soil formation. The warm temperatures permit rapid chemical reactions, and water from spring rains moves through the soil and removes dissolved or suspended material. The remains of plants decompose rapidly, and the organic acids that are produced hasten the formation of clay.

Rainfall is sufficient throughout the county to leach the soils of soluble bases, thus lowering the soil reaction. The soils are commonly slightly acid to strongly acid.

Climate has had a strong influence on the formation of most soils in the county, but climate does not account for all the local differences among the soils. More detailed climatic data are given in the section "General nature of the county."

Plants and animals

Plants, animals, insects, bacteria, and fungi biologically affect soil formation. These biological forces cause gains in the content of organic matter and nitrogen, gains or losses in plant nutrients, and changes in structure and porosity. Plants generally have a greater effect on soil formation than other organisms.

In the southern part of the county, grass is the dominant vegetation. The native perennials have mostly been replaced by annual grasses and forbs. Grass is also dominant in the valleys, but there are scattered areas of valley oak, black oak and live oak. The surface layer of the soils in grasses is thicker and darker than that of the other soils in the area.

During periods of increased rainfall in the hills and mountains, the main type of vegetation is an oak-grass-redwood mixture but shrubs are dominant on the shallow soils on the western side of the valley. Redwoods mixed with Douglas-fir, black oak, live oak, madrone, buckeye, bigleaf maple and a variety of other trees are dominant in moist canyons on the western side of Napa Valley. The drier mountainous slopes of the eastern part of the county support a cover of scrub oak, buckbrush, mountainmahogany, manzanita, and digger pine. Various species of ceanothus and Christmasberry grow on the shallow soils of the still drier southern and western slopes. Where organic residue has accumulated from these plants, a surface mat forms that ranges from less than 1 inch to more than 5 inches thick. The mat consist of fresh and somewhat decomposed needles, leaves, and twigs and is acid in reaction. The reaction of this mat contributes to the reaction of the soils, which generally are also acid. The plants on these soils root in the fractures in the bedrock and cause physical and chemical changes.

In places, roots make up more than 20 percent of the upper 2 or 3 feet of the soil, particularly in areas near trees. Growth and decomposition of roots tend to make the soils more porous. In some wooded areas, shrubs are intermingled with coniferous trees. Shrubs generally grow on shallow soils, or they make up temporary cover that grows after burning or clearing. The soils do not support these shrubs after the tree canopy has been reestablished.

Man has directly or indirectly distributed the soils in the area by mining, clearing or burning the vegetation, harvesting timber, grazing livestock, and cultivating the soils. Burning affects the soils because repeated fire depletes organic matter content and changes the characteristics of the surface layer. Burning also causes changes in the plant community, which is one of the factors of soil formation.

Parent material

Parent material is the unconsolidated mass from which soil forms. It determines the chemical and mineralogical composition of the soil. Many of the parent material characteristics in Napa County have been inherited from geological formations.

Napa County has many geological formations of igneous, sedimentary and metamorphic origin. These rocks differ greatly in age and resistance to weathering, and the differences significantly affect the landscape, and the characteristics of the soils.

Early in geologic time, the coast range area was submerged beneath a sea subject to periodic basal deformation. Sediments began accumulating in these coastal basins. The Miocene Epoch of the seas lingered into the Pliocene Epoch in many areas of the coast range (*5*). At this time, submarine volcanic activity was common and it was especially intense after deposition of the Jurassic Franciscan sediment. As a result of the volcanism, gabbro, diabase, and peridotite intruded the Franciscan rocks, and there were basalt flows (*17*).

Following the period of volcanism, the land surface was at sea level for a long period and thick beds of silt and clay were deposited as the general land area slowly subsided. Surface relief was fairly gentle, and the presence of clay beds resulted in the formation of the Cretaceous Knoxville Formation. During the Pliocene orogeny the entire coast range region was uplifted and the sea receded from the interior, lingering only in coastal embayments (*5*). A crustal disturbance late in the Pliocene Epoch uplifted the land surface to form the Mendocino Plateau. This surface warped downward toward the south, and a zone of weakness developed where the Sonoma Volcanics extruded (*7*). During and after the Pleistocene Epoch, similar uplifts and deformation continued and formed the present landscape.

In a large part of the area, the landscape is dominated by sandstone and shale, but these rocks differ greatly in age and resistance to weathering. These differences in rocks have caused differences in the landscape and the characteristics of the soils.

Cretaceous Knoxville sandstone and shale are along the eastern border of the county. The Bressa, Dibble, Maymen, Sobrante, and Los Gatos soils are extensive

in this area. Ridges generally range from 800 to 2,000 feet in elevation in this area, and canyons are steep.

The soils in the northern section of the county are underlain by Franciscan sedimentary and associated basic intrusive rocks. Henneke and Montara soils formed in material weathered from serpentine and dolerite. These soils are less fertile than those weathered from sedimentary rocks because serpentine and dolerite contain larger amounts of magnesium than calcium. Excess magnesium in soils seriously reduces the intake of calcium by plants (*16*). Soils, such as those in the Guenoc and Hambright series, that formed in material weathered from basalt are adequately supplied with calcium and, therefore, are relatively fertile.

The northern and eastern parts of Napa Valley are made up of Pliocene volcanics, mainly rhyolite, andesite, basalt, and pyroclastic rocks. Soils formed in material weathered from rhyolite and rhyolitic tuff are in the Forward and Kidd series. These soils have a high content of ash and other pyroclastic material. Soils formed in material weathered from basalt and andesite are in the Aiken, Boomer and Hambright series. Intrusions of tuff and conglomerates occur in areas of these soils.

The western side of Napa valley is composed of Jurassic (Franciscan) and Cretaceous sandstone and shale. Felton, Lodo, Millsholm and Felta soils formed in this area. Felta soils formed in material weathered from conglomerate rock on dissected terraces and low hills.

The southern part of the county consists of Eocene marine sandstone and shale and a few basic intrusions on ridgetops. Fagan soil formed in material weathered from these rocks.

Terraces and fanglomerates of Pleistocene age (*7*) are along the margins of the interior valleys. The soils in this area are generally gravelly or cobbly. Characteristics of the soils that formed in material from the formations depend in part on the mineralogical nature of the deposit. Coombs and Perkins soils formed in areas dominated by alluvium from igneous rock, and Pleasanton and Haire soils formed in terrace alluvium from sedimentary rocks that have mixed mineralogy.

The youngest geologic materials are recent alluvial deposits of sand, silt, and clay. Soils that formed in these sediments have a few characteristics that are influenced by mineralogy. Generally, texture and thickness of the soils are more important than the mineralogy. Some of the soils that formed in recent alluvium are those in the Cole, Yolo, Cortina and Clear Lake series.

Time

A long period of time is generally required for soils to form. The differences in the length of time that parent materials have been in place are commonly reflected in the characteristics of the soils.

The soils in Napa County range from young to old. The young soils have little or no profile development, and the old soils have a profile that is well defined.

The Cortina, Pleasanton, and Haire soils are examples of soils that have different characteristics mostly because of the differences in the length of time the soils have been in place. The Cortina soils are young and do not have developed horizons, other than the organic matter accumulation in the A horizon, because the soil has been in place only a short time. The Pleasanton soils are at a slightly higher elevation than the Cortina soils, and they have been stable long enough for an argillic horizon to develop. Thus, the B horizon of the Pleasanton soils contains more clay than the A horizon, any carbonates that were in the parent material have been leached, and the soils are slightly acid. The Haire soils, which are on undulating terraces, are relatively old and are well developed. They have a strongly acid clay B horizon.

Relief

Relief, or the shape of the landscape, affects soil formation through its influence on climate, drainage, erosion, plant cover, and soil temperature.

Elevation and slope are factors of relief. Elevation affects the climate under which soils are formed, and slope affects the degree of erosion and runoff. Lodo and Kidd soils, for example, are steep soils in which erosion removes soil material nearly as fast as it forms and runoff lessens leaching of the soil and weathering of the parent material. Consequently, the soil profile is thin and the soils are shallow to bedrock.

Aspect, or the direction in which a slope faces, has a major effect on the microclimate of the soils (*11*). It largely determines the amount of heat energy that is absorbed from the sun.

Differences in drainage commonly influence the formation of soils. Water readily passes through nearly level or gently sloping soils that are well drained, and leaching is more active in these soils than in those that are less well drained. Poor drainage, saturation for long periods, and poor aeration commonly cause a transfer and reduction of iron in the soils.

Morphology of soils

Several processes have been involved in the formation of soil horizons in the soils of Napa County. The differentiation of horizons in soils in this county is the result of one or more of the following processes: (1) accumulation of organic matter, (2) leaching of calcium carbonate and bases, (3) reduction and transfer of iron, and (4) formation and translocation of silicate clay minerals.

The accumulation of organic matter in the upper part of the profile to form an A1 horizon is a major process of horizon development. The soils of Napa County range from medium to very low in organic matter content. Leaching of carbonates and bases has occurred in nearly all the soils in the county. Many of the soils are moderately leached to strongly leached.

The reduction of iron, called gleying, is evidenced by the gray color of B and C horizons of poorly drained soils in the county. Some horizons contain reddish brown mottles and concretions, which indicates segregation of iron. However, the light gray color of the A2 horizon of the Haire soils has resulted from the translocation of iron in a moderately well drained soil rather than the reduction of iron in poorly drained soil.

In many of the soils, the translocation of clay minerals has contributed greatly to horizon development. In these soils the eluviated A horizon is lower in content of clay and is lighter in color than the B horizon. The B horizon has clay films in pores and on ped surfaces that are evidence of clay illuviation. Leaching of carbonates and other soluble salts preceded the translocation of silicate clays in these soils.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil Taxonomy" (*14*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 14, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent* from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplaquents (*Hapl*, meaning simple horizons, plus *aquent*, the suborder of Entisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extra-

TABLE 14.—*Classification of the soils*

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series

Soil name	Family or higher taxonomic class
*Aiken	Clayey, kaolinitic, mesic Xeric Haplohumults.
Bale	Fine-loamy, mixed, thermic Cumulic Ultic Haploxerolls.
*Boomer	Fine-loamy, mixed, mesic Ultic Haploxeralfs.
Bressa	Fine-loamy, mixed, thermic Typic Haploxeralfs.
Clear Lake	Fine, montmorillonitic, thermic Typic Pelloxererts.
Cole	Fine, mixed, thermic Pachic Argixerolls.
Contra Costa	Fine, mixed, thermic Mollic Haploxeralfs.
Coombs	Fine-loamy, mixed, thermic Ultic Haploxeralfs.
Cortina	Loamy-skeletal, mixed, nonacid, thermic Typic Xerofluvents.
Diablo	Fine, montmorillonitic, thermic Chromic Pelloxererts.
Dibble	Fine, montmorillonitic, thermic Typic Haploxeralfs.
*Egbert	Fine, mixed, thermic Cumulic Haplaquolls.
Fagan	Fine, montmorillonitic, thermic Typic Argixerolls.
Felta	Loamy-skeletal, mixed, thermic Pachic Argixerolls.
*Felton	Fine-loamy, mixed, mesic Ultic Argixerolls.
Forward	Medial, mesic Typic Vitrandepts.
Guenoc	Fine, kaolinitic, thermic Typic Rhodoxeralfs.
Haire	Clayey, mixed, thermic Typic Haploxerults.
Hambright	Loamy-skeletal, mixed, thermic Lithic Haploxerolls.
Henneke	Clayey-skeletal, serpentinitic, thermic Lithic Argixerolls.
Kidd	Medial, mesic Lithic Vitrandepts.
Lodo	Loamy, mixed, thermic Lithic Haploxerolls.
Los Gatos	Fine-loamy, mixed, mesic Typic Argixerolls.
Maxwell	Fine, montmorillonitic, thermic Typic Pelloxererts.
Maymen	Loamy, mixed, mesic Dystric Lithic Xerochrepts.
Millsholm	Loamy, mixed, thermic Lithic Xerochrepts.
Montara	Loamy, serpentinitic, thermic Lithic Haploxerolls.
*Perkins	Fine-loamy, mixed, thermic Mollic Haploxeralfs.
*Pleasanton	Fine-loamy, mixed, thermic Mollic Haploxeralfs.
Reyes	Fine, mixed, acid, thermic Sulfic Haplaquepts.
*Sobrante	Fine-loamy, mixed, thermic Mollic Haploxeralfs.
Tehama	Fine-silty, mixed, thermic Typic Haploxeralfs.
Yolo	Fine-silty, mixed, nonacid, thermic Typic Xerorthents.

grades, which have some properties that are representative of the great groups 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 is thought to typify the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, nonacid, mesic Typic Haplaquents.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

General nature of the county

This section provides general information about physiography, relief, and drainage and about water supply. It also gives facts about the climate and the settlement and development of Napa County.

Physiography, relief, and drainage

Napa County is part of the hilly to steep mountains of the California Coast Range. The county is characterized by a number of northwesterly parallel mountain ridges and intervening valleys of varying widths.

The soils in Napa Valley generally are very deep and have high potential productivity. They are used for vineyards, orchards, and pastures. The soils in the southern part of the valley have lower production potential because they are limited by a strongly developed subsoil. They are used mainly for dryland pasture and for oats and hay.

Maacama Mountain rises abruptly on the west side of Napa Valley. The soils in this area are moderately deep to very shallow over sandstone and shale, and they are used mainly for range, wildlife habitat, and watersheds. A few areas of moderately sloping soils are used for vineyards.

The mountain ridges on the west side of the valley extend as far south as Napa, where the landscape consists of rolling hills and dissected terraces. The soils in this area are moderately deep over sandstone and shale or are shallow to a claypan. They are used for range, pasture, and vineyards.

Howell Mountain borders Napa Valley on the east and rises abruptly from the valley floor. The soils in this area are moderately deep to shallow over rhyolitic tuff and basic igneous rock. They are used for timber, range, wildlife habitat, and watersheds. Where this ridge broadens to a plateau near Angwin, some areas of soils are used for vineyards and orchards.

The plateau drops off to the northeast into Pope Valley, and Vaca Mountain rises abruptly to the east. The soils in the northern and eastern part of the county are moderately deep to shallow over sandstone, shale, and serpentine. They are used for range, wildlife habitat, and watersheds.

The Napa River and its tributaries drain the western part of the county. The Napa River flows southward from north of Calistoga into San Pablo Bay. The northeastern part of the county drains into Lake Berryessa by way of Putah Creek and its tributaries. These tributaries drain Snell, Pope, and Cappel Valleys and part of Chiles Valley.

Water supply

The main source of water for the county is surface water impoundment. Unincorporated communities and areas that do not have access to municipal water supplies depend upon wells and springs.

The City of Napa obtains water from Lake Hennessey, Miliken Reservoir, and the North Bay Aqueduct. Yountville obtains water from Rector Reservoir and from an emergency supply at Conn Aqueduct. The City of St. Helena obtains water from Bell Canyon Reservoir and from a reservoir in a small tributary of York Creek. Conn Aqueduct is secondary source of water for St. Helena. Calistoga obtains water from Kimball Reservoir and from a well in Fiege Canyon.

With the increase in demand for grape production, pumpage of groundwater has increased. Many reservoirs have been built to store water for irrigation, which provides protection against frost damage. The main sources of water for these reservoirs are pumpage of groundwater and the Napa River. Groundwater basins in Napa Valley are naturally recharged.

Climate

In summer, Napa County is protected from the hot weather of the Central Valley of California by the coastal mountain ranges. The Pacific Ocean provides a source of cool, moist air in summer, and this steady flow of marine air holds temperatures at a moderate level.

Temperature and precipitation information from Napa and from Pacific Union College at Angwin are shown on table 15. The data in the table were compiled from records of weather stations of the National Weather Service in Napa County.

Temperature patterns vary throughout the area because of the mountainous terrain. The range in temperature is much greater in the higher mountainous valleys than in other areas of the county.

The greatest variation in temperature occurs in summer. The average daily maximum temperature in July is 82° F. at Napa and in the nineties at Lake Berryessa. The highest temperature is more than 100°

TABLE 15.—*Temperature and precipitation data*

[Data from Angwin]

Month	Temperature					Average precipitation
	Highest	Average maximum	Average	Average minimum	Lowest	
	°F	°F	°F	°F	°F	In
January	75	50.7	44.0	37.2	19	9.25
February	76	55.0	47.0	39.0	20	6.62
March	79	57.4	47.9	38.4	23	4.82
April	86	64.5	53.0	41.5	25	2.90
May	94	71.9	58.6	45.3	27	0.87
June	106	80.0	65.1	50.2	33	0.37
July	105	88.1	71.1	54.1	37	0.02
August	101	86.7	69.9	53.1	39	0.13
September	108	81.7	66.8	51.9	35	0.30
October	98	71.8	60.5	49.1	30	2.46
November	86	59.5	51.4	43.2	26	4.70
December	75	52.7	45.8	38.8	23	8.27
Year						40.74
[Data from Napa]						
January	75	57.7	47.6	37.4	19	4.90
February	85	61.6	50.6	39.6	24	4.30
March	90	65.9	53.3	40.8	23	3.30
April	94	70.1	56.5	43.0	29	1.70
May	103	74.7	60.6	46.6	32	0.90
June	108	79.7	64.9	50.1	38	0.20
July	107	82.2	67.3	53.3	41	(1)
August	105	81.7	66.6	51.4	37	(1)
September	109	83.2	66.6	49.9	36	0.20
October	101	77.2	61.7	46.5	28	1.20
November	89	68.0	54.6	41.1	25	2.30
December	77	59.5	49.0	38.5	17	4.90
Year						23.90

[1] Trace.

in most of the county during the warm season, and it is more than 110° in the northeastern part. The average daily minimum temperatures are in the fifties throughout the county during the warm season.

Winters are generally mild, but there are occasional cold spells. In January, the average minimum temperature is in the thirties throughout the county, but a low of 15° has been recorded. Relatively warm temperatures are common in the afternoon. In January the average daily maximum temperature is in the middle fifties.

The last freezing temperature in spring generally occurs in March in most areas of the county, but it commonly occurs in February in the northeastern part. The first freezing temperature in fall generally occurs in November in most of the county and as late as December in the warmer northeastern part.

The growing season, which is the period between the last freezing temperature in spring and the first in fall, ranges from 215 to 260 days in Napa Valley. The growing season near Lake Berryessa is about 285 days. The vicinity of Lake Berryessa has greater climatic extremes than other parts of the county because of the mountainous terrain, which limits the effects of the Pacific Ocean.

Most of the annual precipitation falls during the period of November through April. The average annual precipitation ranges from about 20 inches in the extreme northeastern corner and extreme southern boundary of the county to 24 to 35 inches in Napa Valley. The average precipitation increases with elevation to a maximum of about 55 inches near Mount St. Helena. Figure 1 shows the distribution of precipitation in Napa County.

Total precipitation varies from year to year. For example, in 9 years out of 10, it ranges from about 13 to 34 inches at Napa and from less than 21 to about 50 inches at St. Helena. Table 16 shows the probability of receiving the total annual precipitation indicated at five weather stations in Napa County.

The greatest amount of rainfall in 1 hour is expected to be 0.8 inch about once in 2 years, and it is 1.6 inches once in 100 years in the southern part of Napa Valley and the eastern part of Napa County. In the northern part of Napa Valley and the western part of Napa County, the range is from 0.9 inch in 1 hour once in 2 years to 2.1 inches in 1 hour once in 100 years.

The average annual snowfall at the lower elevations in the county is less than 1 inch. At the higher eleva-

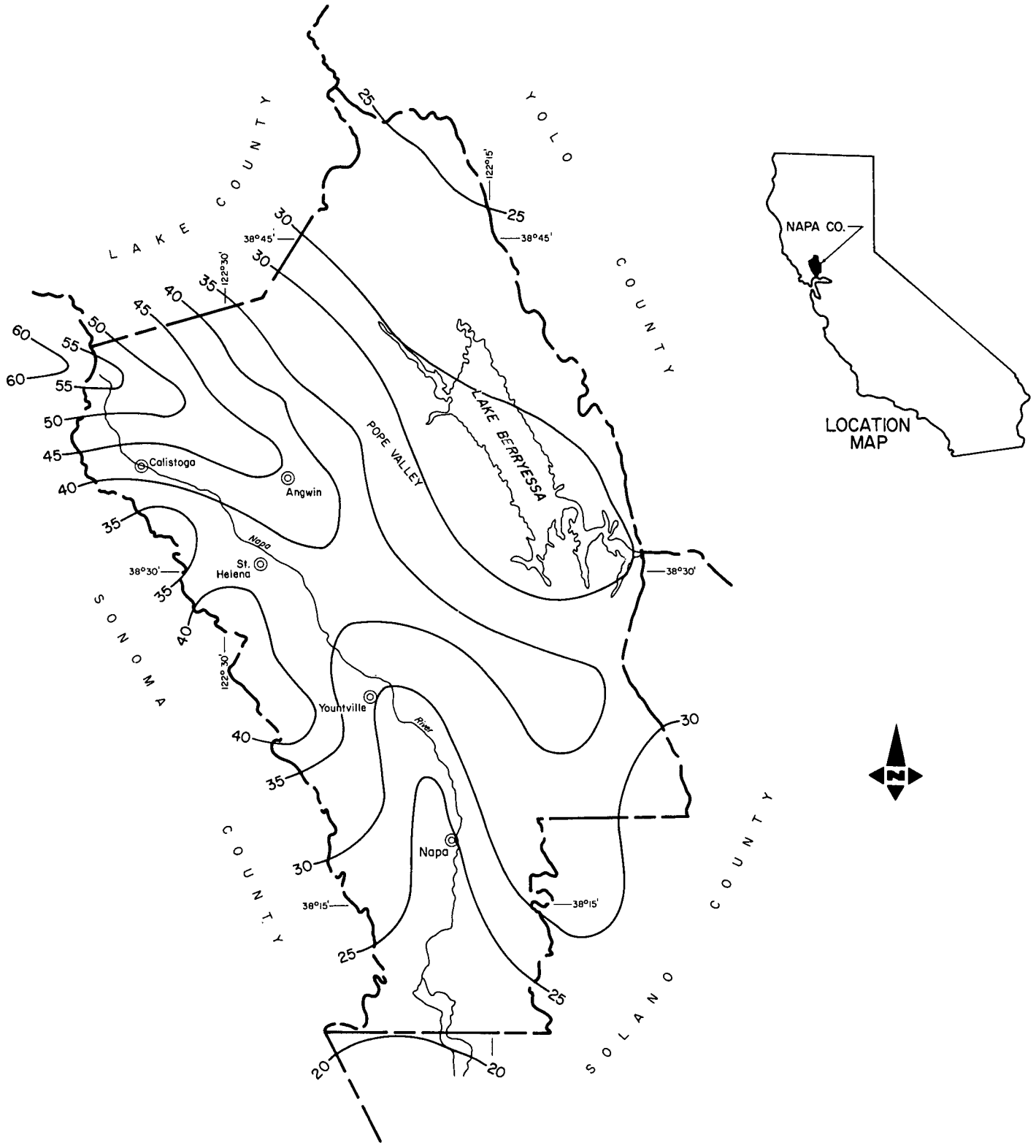

Figure 1.—**Average annual precipitation in Napa County.**

TABLE 16.—*Probability of receiving less than indicated annual precipitation*

Station	Probability (percent)								
	5	10	25	33	50	67	75	90	95
	In	*In*	*In*	*In*	*In*	*In*	*In*	*In*	*In*
Angwin (Pacific Union College)	22.2	25.6	33.7	36.6	40.6	44.4	48.0	58.7	64.6
Lake Berryessa	14.1	16.2	21.1	22.8	25.0	26.9	28.8	34.5	37.3
Mt. St. Helena	25.0	30.3	40.4	45.7	55.8	66.9	73.3	92.4	104.0
Napa	14.5	16.6	18.4	19.9	23.1	36.5	28.5	34.0	38.0
St. Helena	19.2	22.0	28.8	31.3	34.5	37.3	40.1	48.6	53.0

tions, the annual average is 3.1 inches at Angwin and 18.3 inches at Mount St. Helena.

Table 17 shows monthly and annual evaporation recorded at three stations in Napa County previous to 1970. All records of evaporation recorded were from a Class A pan that is 4 feet in diameter.

Records covering a 2-year period at the Napa County Airport show that the wind direction is dominantly from the south and southwest, but it is also from the east and west. A weak downdraft has also been recorded. Strong north winds that follow winter storms frequently cause a sudden drop in temperature.

Winds of less than 5 miles per hour were recorded slightly less than 25 percent of the time. Winds of 25 miles per hour or more were recorded less than 1 percent of the time. It is estimated that winds reach speeds of 40 miles per hour in most parts of the county as often as once in 2 years and speeds of 80 miles per hour once in 50 years.

The average relative humidity in the county ranges from 75 percent in winter to about 60 percent in summer and fall. In summer, the difference in humidity between the marine air and the drier and warmer air of the inland locations is great.

Napa County receives about 50 percent of the total possible sunshine in winter and about 80 percent in summer. Most of the cloudiness in winter is associated with storms that move inland from the Pacific Ocean. The cloud patterns of these storms are nearly the same in all parts of the county. In summer the cloud patterns are more localized. Typically, the clouds move inland late in the afternoon and spread across much of the county. By late morning the cloud cover starts to dissipate.

Settlement and development

The Indian civilization was in existence in the survey area 4,000 years ago (*8*). The county derives its name from the Nappa Indians, who inhabited the area until about 1870. The population of Napa County was 76,819 in 1970.

The first recorded expedition to Napa Valley was made in 1823 by Francisco Castro. George C. Yount settled in Napa Valley in 1835 and was soon followed by other settlers. Yount received the Caymus Grant from the Government of Mexico in 1836, and by 1845 almost the entire valley had been taken up in large grants. Napa County was created on February 8, 1850, and included the area that is now Lake County.

Grains, mainly wheat, were grown in the area during the early days of settlement, but orchards became dominant in the 1860's. Grapes were introduced in the area in the 1850's from cuttings supplied by the Spanish Mission in Sonoma and San Rafael. Vineyards occupy the major part of the acreage of Napa Valley.

The major industries in the county are winemaking, the fabrication of steel pipe, and the production of construction materials, sportswear, and leather goods. Most transportation in the area is by automobile and truck. Bus service provides regular transportation to areas outside the county.

Napa County has high schools in the communities of Napa, St. Helena, and Calistoga. Numerous grammar

TABLE 17.—*Monthly and*

Station Data (Class A Pan)	Years of Record	Jan.	Feb.	Mar.	Apr.	May
Lake Berryessa	1958–70					
Greatest		2.95	4.73	5.15	7.43	10.03
Average		1.57	2.16	3.82	5.88	9.01
Least		.79	.81	2.35	2.68	7.51
Lake Curry	1931–45					
Greatest		1.87	3.45	4.73	6.79	9.92
Average		1.35	2.00	3.44	5.03	7.15
Least		.99	1.00	2.40	3.57	5.03
Monticello Dam	1958–68					
Greatest		1.97	3.52	6.59	8.42	10.29
Average		1.23	2.00	3.43	5.22	7.51
Least		.88	1.12	2.36	2.14	5.73

schools are scattered throughout the rural areas. Napa Junior College is south of the City of Napa, and Pacific Union College is at Angwin. Medical facilities in the county include hospitals at Napa and Deer Park.

Electricity, natural gas, and telephone service are supplied to nearly all parts of the county. Bottled gas or liquid petroleum is available through private companies.

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Glossary

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.

Aggregation, soil. The cementing or binding together of several soil particles into a secondary unit, aggregate, or granule. Water-stable aggregates, which will not disintegrate easily, are especially important to soil structure.

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

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

Argillic horizon. See Diagnostic horizons.

Available water 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 depth.

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

Bulk density, soil. The weight of oven-dry soil per unit volume. Bulk density is commonly expressed in grams per cubic centimeter or pounds per cubic foot.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Cambic horizon. See Diagnostic horizons.

Clay. As a soil separate, the mineral soil particles less than 0.002 milimeter 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 roots channels. Synonyms: clay coat, clay skin.

annual evaporation

June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year
12.94	15.06	13.00	9.44	7.29	4.08	2.98	87.06
11.03	13.48	12.10	9.19	5.73	2.59	1.69	78.25
8.76	12.02	10.31	7.20	4.51	1.97	.70	66.93
10.69	13.06	10.73	8.91	6.28	3.78	1.91	73.33
8.96	10.30	9.55	7.30	4.91	2.50	1.36	63.85
7.78	8.83	8.06	4.59	3.60	1.70	.80	56.38
10.63	12.60	10.93	8.25	6.67	3.01	2.16	69.17
9.42	11.14	10.07	7.68	5.11	2.05	1.18	66.04
7.14	10.20	9.03	6.51	3.80	1.40	.74	56.30

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.

Color. See Munsell notation.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Compressible. Excessive decrease in volume of soft soil under load.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diagnostic horizons. As used in the soil classification system of the National Cooperative Soil Survey in the United States, combinations of specific soil characteristics that indicate certain classes of soils. Those that occur at the soil's surface are called epipedons. Those below the surface are called diagnostic subsurface horizons.

Argillic horizon—A subsurface horizon into which clay has moved. It has about 20 percent more clay than the horizons above. The presence of clay films on ped surfaces and in soil pores is evidence of clay movement.

Cambic horizon.—A subsurface horizon that is finer than loamy fine sand in texture and in which materials have been altered or removed but have not accumulated. Elimination of fine stratification; changes caused by wetness, such as gray color and mottling; redistribution of carbonates; and yellower or redder color than in underlying horizons are evidence of alteration.

Mollic epipedon.—A dark-colored surface horizon, generally more than 7 inches thick. It contains more than 1 percent organic matter and has more than 50 percent base saturation. It is not both hard and massive when dry. Color is black, very dark brown, very dark gray, or very dark grayish brown and is darker than 3.5 in value when moist and 5.5 in value when dry and less than 3.5 in chroma when moist.

Ochric epipedon.—A surface horizon that is too light in color (higher in value or chroma than a mollic epipedon), too low in organic matter, or too thin to be a mollic or umbric epipedon.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly previous layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly previous layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Effective rooting depth. The depth to which a soil is readily penetrated by roots and used for extraction of water and plant nutrients. The classes of effective rooting depth are *very deep*, more than 60 inches; *deep*, 40 to 60 inches; *moderately deep*, 20 to 40 inches; *shallow*, 10 to 20 inches; and *very shallow*, less than 10 inches.

Erosion. The wearing away of the land surface by running 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 a bare surface.

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

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; occasional that it occurs on an average of once or less in 2 years; and frequent that it occurs on an average of more than once in 2 years. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, and long if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

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

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

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term

"gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming 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.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

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

Illuviation. The accumulation of material in a soil horizon through the deposition of suspended material and organic matter removed from horizons above. Since part of the fine clay in the B horizon (subsoil) of many soils has moved into the B horizon from the A horizon above, the B horizon is called an illuvial horizon.

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

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Low strength. Inadequate strength for supporting loads.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, and many; size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

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

Organic matter. Dynamic material composed of compounds of carbon. Organic matter remains in the soil while it passes through several slow biological oxidation changes that reduce it ultimately to carbon dioxide, water, and mineral elements. The more advanced state of decomposition is called humus. Organic matter is a source of plant nutrients, particularly nitrogen, phosphorus, and sulfur. Organic matter is a temporary stage in a natural cycle. Much of its value results from its breakdown.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch), moderately slow (0.2 to 0.63 inch), moderate (0.63 to 2.00 inches), moderately rapid (2.00 to 6.30 inches), rapid (6.30 to 20.0 inches), and very rapid (more than 20.0 inches).

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

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

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

Reaction, soil. The degree 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		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

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

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

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

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

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.

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

Slope class. The slope classes used in this survey are as follows:

Percent	*Simple slopes*	*Complex slopes*
0 to 2	nearly level or level	nearly level or level
2 to 5	gently sloping	undulating
5 to 9	moderately sloping	gently rolling
9 to 15	strongly sloping	rolling
15 to 30	moderately steep	hilly
30 to 50	steep	steep
50 to 75	very steep	very steep
more than 75	extremely steep	extremely steep

Slow intake. The slow movement of water into the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that 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.

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

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

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

Substratum. The part of the soil below the solum.

Surface soil. 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."

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 or management.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by 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, silt loam, 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. Otherwise suitable soil material too thin for the specified use.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Wetness. Soil is wet during period of use.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or a range site, read the introduction to the section it is in for general information about its management. A dash in the range column indicates that the mapping unit is not suited to range and was not placed in a range site.

Map symbol	Mapping unit	Page	Capability unit		Range site	
			Symbol	Page	Name	Page
100	Aiken loam, 2 to 15 percent slopes	7	IIIe-1 (5)	38	----------	--
101	Aiken loam, 15 to 30 percent slopes	7	IVe-1 (5)	39	----------	--
102	Aiken loam, 30 to 50 percent slopes	8	VIe-1 (5)	40	----------	--
103	Bale loam, 0 to 2 percent slopes	8	IIw-2 (14)	38	----------	--
104	Bale clay loam, 0 to 2 percent slopes	9	IIw-2 (14)	38	----------	--
105	Bale clay loam, 2 to 5 percent slopes	9	IIw-2 (14)	38	----------	--
106	Bale complex, 0 to 2 percent slopes, seeped	9	VIIIw-1 (14, 15)	41	----------	--
107	Boomer loam, 2 to 15 percent slopes	10	IIIe-1 (5)	38	----------	--
108	Boomer gravelly loam, 15 to 30 percent slopes	10	IVe-1 (5)	39	----------	--
109	Boomer gravelly loam, 30 to 50 percent slopes	10	VIe-1 (5)	40	----------	--
110	Boomer-Forward-Felta complex, 5 to 30 percent slopes	10	IVe-1 (5)	39	----------	--
111	Boomer-Forward-Felta complex, 30 to 50 percent slopes	10	VIe-1 (5)	40	----------	--
112	Bressa-Dibble complex, 5 to 15 percent slopes	11	IIIe-1 (15)	38	Fine Loamy	46
113	Bressa-Dibble complex, 15 to 30 percent slopes	11	IVe-1 (15)	39	Fine Loamy	46
114	Bressa-Dibble complex, 30 to 50 percent slopes	11	VIe-1 (15)	40	Fine Loamy	46
115	Bressa-Dibble complex, 50 to 75 percent slopes	11	VIIe-1 (15)	40	Fine Loamy	46
116	Clear Lake clay, drained	12	IIs-5 (14)	38	----------	--
117	Clear Lake clay, overwashed	12	IIIw-5 (14)	39	----------	--
118	Cole silt loam, 0 to 2 percent slopes	13	IIw-2 (14)	38	----------	--
119	Cole silt loam, 2 to 5 percent slopes	13	IIw-2 (14)	38	----------	--
120	Contra Costa loam, 5 to 15 percent slopes	14	IVe-3 (15)	39	Fine Loamy	46
121	Contra Costa gravelly loam, 5 to 15 percent slopes	14	IVe-3 (15)	39	Fine Loamy	46
122	Coombs gravelly loam, 0 to 2 percent slopes	15	IIIs-3 (14)	39	----------	--
123	Coombs gravelly loam, 2 to 5 percent slopes	15	IIIe-3 (14)	38	----------	--
124	Cortina very gravelly loam, 0 to 5 percent slopes	15	IVs-4 (14)	40	----------	--
125	Cortina very stony loam, 0 to 5 percent slopes	15	IVs-4 (14)	40	----------	--
126	Diablo clay, 5 to 9 percent slopes	16	IIe-5 (15)	37	Clayey	45
127	Diablo clay, 9 to 15 percent slopes	16	IIIe-5 (15)	38	Clayey	45
128	Diablo clay, 15 to 30 percent slopes	16	IVe-5 (15)	39	Clayey	45
129	Diablo clay, 30 to 50 percent slopes	16	VIe-1 (15)	40	Clayey	45
130	Egbert silty clay loam	18	IVw-3 (14)	39	----------	--
131	Fagan clay loam, 5 to 15 percent slopes	19	IIIe-3 (15)	38	Fine Loamy	46
132	Fagan clay loam, 15 to 30 percent slopes	19	IVe-3 (15)	39	Fine Loamy	46
133	Fagan clay loam, 30 to 50 percent slopes	19	VIe-1 (15)	40	Fine Loamy	46
134	Fagan clay loam, 30 to 50 percent slopes, slipped	19	VIIe-1 (15)	40	Fine Loamy	46
135	Felton gravelly loam, 15 to 30 percent slopes	20	IVe-1 (5)	39	----------	--
136	Felton gravelly loam, 30 to 50 percent slopes	20	VIe-1 (5)	40	----------	--

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Range site	
			Symbol	Page	Name	Page
137	Felton gravelly loam, 50 to 75 percent slopes	20	VIIe-1 (5)	40	----------	--
138	Forward gravelly loam, 2 to 9 percent slopes	21	IIIe-1 (5)	38	----------	--
139	Forward gravelly loam, 9 to 30 percent slopes	21	IVe-1 (5)	39	----------	--
140	Forward gravelly loam, 30 to 75 percent slopes	21	VIIe-1 (5)	40	----------	--
141	Forward-Kidd complex, 50 to 75 percent slopes	21	VIIe-1 (5)	40	----------	--
142	Guenoc loam, 30 to 50 percent slopes	22	VIe-1 (15)	40	Loamy Upland	47
143	Guenoc-Rock outcrop complex, 5 to 30 percent slopes	22	VIe-1 (15)	40	Loamy Upland	47
144	Guenoc-Rock outcrop complex, 30 to 75 percent slopes	22	VIIe-1 (15)	40	Loamy Upland	47
145	Haire loam, 0 to 2 percent slopes	23	IIIs-3 (14)	39	Claypan	48
146	Haire loam, 2 to 9 percent slopes	23	IIIe-3 (14)	38	Claypan	48
147	Haire clay loam, 0 to 2 percent slopes	23	IIIs-3 (14)	39	Claypan	48
148	Haire clay loam, 2 to 9 percent slopes	24	IIIe-3 (14)	38	Claypan	48
149	Haire clay loam, 9 to 15 percent slopes	24	IVe-3 (15)	39	Claypan	48
150	Haire clay loam, 15 to 30 percent slopes	24	VIe-1 (15)	40	Claypan	48
151	Hambright-Rock outcrop complex, 2 to 30 percent slopes	24	VIe-1 (15)	40	Very Shallow Rocky	46
152	Hambright-Rock outcrop complex, 30 to 75 percent slopes	24	VIIe-1 (15)	40	Very Shallow Rocky	46
153	Henneke gravelly loam, 5 to 30 percent slopes	25	VIIe-1 (15)	40	Rocky Serpentine	48
154	Henneke gravelly loam, 30 to 75 percent slopes	25	VIIe-1 (15)	40	Rocky Serpentine	48
155	Kidd loam, 15 to 30 percent slopes	26	VIe-1 (15)	40	Very Shallow Rocky	46
156	Kidd loam, 30 to 75 percent slopes	26	VIIe-1 (15)	40	Very Shallow Rocky	46
157	Lodo-Maymen-Felton association, 30 to 75 percent slopes	26	VIIe-1 (15)	40	----------	--
	Lodo part	--	----------	--	Shallow Coarse Loamy	46
	Maymen part	--	----------	--	Shallow Coarse Loamy	46
	Felton part	--	----------	--	----------	--
158	Los Gatos loam, 5 to 30 percent slopes	27	IVe-1 (15)	39	Loamy Upland	47
159	Los Gatos loam, 30 to 50 percent slopes	27	VIe-1 (15)	40	Loamy Upland	47
160	Los Gatos loam, 50 to 75 percent slopes	27	VIIe-1 (15)	40	Loamy Upland	47
161	Maxwell clay, 2 to 9 percent slopes	28	IVs-9 (15)	40	Serpentine	48
162	Maymen-Los Gatos complex, 50 to 75 percent slopes	29	VIIe-1 (15)	40	----------	--
	Maymen part	--	----------	--	Shallow Coarse Loamy	46
	Los Gatos part	--	----------	--	Loamy Upland	47
163	Maymen-Millsholm-Lodo association, 30 to 75 percent slopes	29	VIIe-1 (15)	40	Shallow Coarse Loamy	46
164	Millsholm loam, 15 to 30 percent slopes	29	VIe-1 (15)	40	Shallow Fine Loamy	47
165	Millsholm loam, 30 to 75 percent slopes	29	VIIe-1 (15)	40	Shallow Fine Loamy	47

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Range site	
			Symbol	Page	Name	Page
166	Montara clay loam, 5 to 30 percent slopes----	30	VIIe-1 (15)	40	Serpentine	48
167	Montara clay loam, 30 to 50 percent slopes---	30	VIIe-1 (15)	40	Serpentine	48
168	Perkins gravelly loam, 2 to 5 percent slopes----------	31	IIe-3 (14)	37	----------	--
169	Perkins gravelly loam, 5 to 9 percent slopes----------	31	IIe-3 (14)	37	----------	--
170	Pleasanton loam, 0 to 2 percent slopes-------	32	I (14)	37	----------	--
171	Pleasanton loam, 2 to 5 percent slopes-------	32	IIe-1 (14)	37	----------	--
172	Reyes silty clay loam----------	33	IVw-9 (14)	40	----------	--
173	Reyes silty clay loam, salt ponds----------	33	VIIIw-1 (14)	41	----------	--
174	Riverwash----------	33	VIIIw-1 (14)	41	----------	--
175	Rock outcrop----------	33	VIIIs-1 (15)	41	----------	--
176	Rock outcrop-Hambright complex, 50 to 75 percent slopes----------	33	VIIIs-1 (15)	41	----------	--
177	Rock outcrop-Kidd complex, 50 to 75 percent slopes----------	33	VIIIs-1 (15)	41	----------	--
178	Sobrante loam, 5 to 30 percent slopes--------	34	IVe-1 (15)	39	Loamy Upland	47
179	Sobrante loam, 30 to 50 percent slopes-------	34	VIe-1 (15)	40	Loamy Upland	47
180	Tehama silt loam, 0 to 5 percent slopes------	35	IIe-3 (14)	37	----------	--
181	Yolo loam, 0 to 2 percent slopes----------	35	I (14)	37	----------	--
182	Yolo loam, 2 to 5 percent slopes----------	35	IIe-1 (14)	37	----------	--

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