Issued May 1968

SOIL SURVEY

Glenn County, California

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service and Forest Service
In cooperation with
UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION

Major fieldwork for this survey was completed in the period 1951–58. Soil names and descriptions were approved in 1964. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1960–65. This survey was made cooperatively by the University of California Agricultural Experiment Station, the Forest Service, and the Soil Conservation Service. It is part of the technical assistance furnished to Glenn County and to the Elk Creek Soil Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Glenn County contains information that can be applied in managing farms, ranches, 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 Glenn 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 for the capability unit, or any other group 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 in the section that describes the soils and in the section that discusses management of the soils for cultivated crops and for orchard crops.

Foresters and others can refer to the section "Woodland," to learn about the suitability of the soils for trees.

Ranchers and others interested in range can find, under the section "Pasture and Range," information about the suitability of the soils for range, and also the plants that grow on each range site.

Engineers and builders will find under "Engineering Uses of the Soils" 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 and Classification of Soils."

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

Newcomers in Glenn County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

Cover Picture

Typical area in the central foothills of Glenn County. The Millsholm and Sehorn soils under oak and grass in the background are used for range, and the Myers and Hillgate soils on the flats are dryfarmed to barley.

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NOTICE TO LIBRARIANS

Series year and series number are no longer shown on soil surveys. See explanation on next page.

Issued May 1968

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.
Series 1958, No. 34, Grand Traverse County, Mich.
Series 1959, No. 42, Judith Basin Area, Mont.
Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1961, No. 42, Camden County, N.J.
Series 1962, No. 13, Chicot County, Ark.
Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF GLENN COUNTY, CALIFORNIA

BY E. L. BEGG, UNIVERSITY OF CALIFORNIA

FIELDWORK BY E. L. BEGG AND G. F. HAFER, UNIVERSITY OF CALIFORNIA, AND R. E. NELSON, U.S. FOREST SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE AND THE UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION [1]

GLENN COUNTY is in the north-central part of California (fig. 1). It is part of the Sacramento Valley and the Northern Coast Ranges and extends westward from the Sacramento River at an elevation of about 60 feet to about 7,500 feet near Black Butte along the crest of the Coast Ranges. The county is roughly rectangular and is about 28½ miles wide and 58 miles long. The total extent of the area is approximately 1,322 square miles, or 846,080 acres. Of this, 360 square miles is in the mountains, 432 square miles is in the foothills, and 530 square miles is in the valleys.

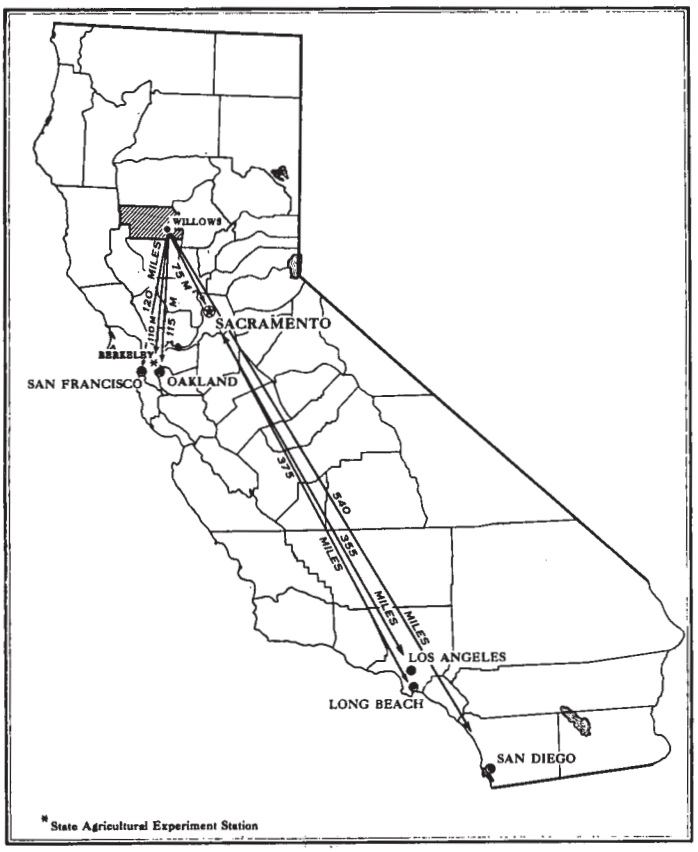

Figure 1.—Location of Glenn County in California.

Willows, the largest city in the county, is the county seat. It is in the central part of the valley, and the Southern Pacific Railroad and U.S. Highway 99W go through this city. Other important communities are Orland, Hamilton City, and Butte City.

Most of the western mountainous areas are within the Mendocino National Forest. Forests of various kinds of conifers and hardwoods grow at the higher elevations, and brush occupies much of the acreage at lower elevations. In the central foothills the vegetation consists of grasses or of trees and grasses. Here the areas are used mainly for dryfarmed grain or as annual range for sheep and cattle. In the Sacramento Valley part of the county, about one-half of the acreage is irrigated. The soils under irrigation are used for rice, Ladino clover, milo, pasture plants, alfalfa, almonds, olives, prunes, pears, walnuts, oranges, and other field, forage, and orchard crops. Dryfarmed crops grown in the valley include barley, safflower, and annual range and pasture.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Glenn County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They examined roadcuts and ditchbanks, dug pits, and bored many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with

[1] Upland parts of Glenn County were mapped by the State Cooperative Soil-Vegetation Survey. This was a cooperative undertaking of the California Division of Forestry, the Pacific Southwest Forest and Range Experiment Station of the U.S. Forest Service, and the University of California. Mapping in the Mendocino National Forest was done cooperatively with the California Region, U.S. Forest Service.

those in counties nearby and in places more distant. They classified and named the soils according to uniform, nationwide procedures. For successful use of this survey, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles 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 similar 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. Orland and Willows, 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 go with their behavior in the natural landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Tehama fine sandy loam and Tehama silt loam are two soil types in the Tehama series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Newville gravelly loam, 3 to 15 percent slopes, is one of several phases of Newville gravelly loam, a soil type that ranges from gently undulating to very steep.

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 greatly help in drawing soil boundaries accurately. The soil map at the back of this report 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 management of farms and fields, a mapping unit is nearly equivalent to a soil type or phase of a soil type. 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 type or soil phase.

In preparing some detailed maps, the soil scientists have a problem delineating areas where different kinds of soils are so intricately mixed, and so small in size that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Orland-Cortina complex.

Some mapping units contain more than one kind of soil in a pattern more open and less intricate than that of a soil complex. Such a mapping unit is called a soil association. A soil association differs from a soil complex in that the component soils can be mapped separately, at ordinary scales such as 4 inches per mile, if practical advantages make the effort worthwhile. Separate mapping at ordinary scales is not possible for a soil complex. A soil association, like a soil complex, is named for the major soils in it, for example, Altamont-Nacimiento association, 3 to 15 percent slopes.

The soil scientists may also show as one mapping unit two or more soils that have differences not significant enough to make it practical to show them separately on the map. Such a mapping unit is called an undifferentiated soil group. An example is Altamont and Millsholm soils, 30 to 65 percent slopes, severely eroded.

On most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be classified by soil series. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Riverwash or Rock land, and are called land types.

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 same kinds of soils 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 soils. Yields under defined management are estimated for all the soils.

But only part of a 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 a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. On the basis of yield and practice tables and other data, the soil scientists set up trial groups; then they test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Finally they 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

The general soil map at the back of this report shows, in color, the soil associations in Glenn County. A soil association is a landscape that has its own distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily

differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

Glenn County is partly in the Coast Range Mountains and partly in the Great Valley of California. Based on the physiography, there are five major parts in the county. These are (1) the mountains, (2) the foothills, (3) the older alluvial fans and terraces, (4) the basins, and (5) the more recent alluvial fans and flood plains. Three or more associations are in each part.

Soils of the Mountains

The soils in the mountains are shallow to deep, well-drained to excessively drained, and mostly steep to very steep. The areas are in the western part of the county in the Coast Range Mountains. Rocks crop out in small areas.

In the mountains the elevation ranges from about 1,200 feet to nearly 7,500 feet at Black Butte Mountain, and the precipitation from about 25 inches at the lower elevations to more than 60 inches on the high ridges and peaks. Much of the precipitation in the high areas comes as snow, which remains in many places on protected, north-facing slopes until early in July. At the lower elevations the vegetation is chiefly brush or trees and grasses. As the precipitation and elevation increase, however, the vegetation changes and forests of conifers and hardwoods cover the higher areas.

Five of the soil associations in Glenn County are in the mountains.

1. Sheetiron-Josephine association

Shallow to deep, well-drained to somewhat excessively drained, gravelly soils

Most of this soil association is in the mountains in an area 5 to 12 miles wide that extends northward from Low Gap to Mendocino Pass near the Tehama County line, but a small area is near Valley View Lookout. The soils are well drained to somewhat excessively drained, are gravelly, and are shallow to deep over schistose and partly metamorphosed sedimentary rock. They range from gently sloping to very steep but are dominantly steep and very steep. Elevation ranges from 2,000 to 6,500 feet, and precipitation ranges from 35 to 60 inches annually. The vegetation is mainly various kinds of conifers but includes a few hardwoods and low shrubs. The association makes up about 12 percent of the county.

The Sheetiron soils make up about 85 percent of this association, and the Josephine soils less than 5 percent. The remaining acreage is mostly Colluvial land, small areas of the Masterson and Hugo soils, and less extensive areas of the Hulls, Maymen, and Tyson soils.

The Sheetiron and Josephine soils formed in material from schistose sedimentary rock. Sheetiron soils, the most extensive, are shallow or moderately deep and are well drained to somewhat excessively drained. Their surface layer is thin, grayish-brown gravelly loam, and their subsoil is pale-brown or light yellowish-brown heavy gravelly loam.

Josephine soils are moderately deep or deep and are well drained. They have a surface layer of pale-brown or brown gravelly loam. Their subsoil is reddish-yellow to red gravelly clay loam or light clay.

Minor soils in this association are those of the Masterson and Hugo series. Masterson soils are moderately deep or deep and are well drained. The Hugo soils, on unaltered sandstone and shale, are similar to the Sheetiron soils, but they generally have a thicker surface layer and a somewhat lighter colored subsoil.

Other minor but less extensive areas in this association are occupied by Colluvial land and by soils of the Hulls, Maymen, and Tyson series, and by Millsholm gravelly loams.

The soils in this association are well suited to trees. Christmas trees are harvested from a few areas at an elevation of more than 6,500 feet, and a small acreage of Josephine soils is in apple orchards. The remaining areas are used for wildlife, recreation, and water supply.

2. Neuns-Colluvial land association

Shallow to deep, well-drained to somewhat excessively drained, stony and rocky soils

This soil association is in the southwest corner of the county on slopes of St. John Mountain and Snow Mountain or is in the northwestern part of the county on slopes of Black Butte Mountain. The soils are hilly to very steep and are well drained to somewhat excessively drained. They are stony and rocky, and in many places rocks crop out. These soils are shallow to deep over metavolcanic rock (greenstone). Elevation ranges from 3,000 to 7,500 feet. Precipitation ranges from 35 to 60 inches, and much of it falls as snow at the higher elevations. At the lower elevations, the vegetation is various kinds of conifers and hardwoods, but at elevations of more than 5,500 feet, true fir trees grow. This association makes up about 1.3 percent of the county.

The Neuns soils make up about 50 percent of the acreage of this soil association, and the minor Hohmann soils less than 10 percent. Most of the remaining 40 percent of the association is Colluvial land and small areas of Rock land, Rock outcrop, and soils of the Hugo and Dubakella series.

Neuns soils are shallow to deep, are well drained, and are cobbly or stony. They have a thin, dark-brown surface layer and a yellowish-brown to light reddish-brown subsoil and are medium acid to strongly acid. Colluvial land is a heterogeneous mixture of soil material and rock fragments.

Hohmann soils are moderately deep or deep, slightly acid to medium acid, and medium textured to moderately fine textured. They are reddish gray or purplish in color, are rocky or stony, and have many rock outcrops. Dubakella soils, on serpentine, are stony, shallow or moderately deep, and reddish brown.

The soils in this association are used for timber, for water supply, and as wildlife and recreation areas. Christmas trees are harvested from some areas. Because of the many rock outcrops and stones, these soils are more difficult to harvest and manage than other soils in timber and are less productive.

3. Maymen-Los Gatos association

Very shallow to moderately deep, well-drained to excessively drained, gravelly soils

The soils in this association are in the mountains under brush in areas below soils of the Sheetiron-Josephine

association, which have a cover of timber. They form a nearly continuous area, less than 1 to 10 miles wide, that extends northward from Red Bridge, near the Colusa County line, to north of Valley View Lookout, near the Tehama County line. The soils are very shallow to moderately deep, are predominantly steep to very steep, and are well drained to excessively drained. They are gravelly and are on schistose and partly metamorphosed sedimentary rock at elevations of 1,200 to 5,000 feet. Precipitation ranges from about 25 inches at lower elevations to more than 45 inches at higher areas. The vegetation is chiefly semidense to dense stands of shrubs, but canyon live oaks grow at the higher elevations and on north-facing slopes. The association covers 9.3 percent of the county.

Maymen soils occupy 75 percent of the acreage of this association, and Los Gatos soils about 20 percent. The remaining 5 percent consists of soils of the Parrish, Tyson, and Millsholm series and of Colluvial land.

Maymen soils are very shallow or shallow, are well drained to excessively drained, and are highly erodible. They have a thin surface layer of pale-brown to grayish-brown gravelly loam. The subsoil is similar to that of the surface layer in texture, but it is pale brown to light yellowish brown in color.

Los Gatos soils are shallow to moderately deep and are well drained or somewhat excessively drained. They have a surface layer of brown gravelly loam and a subsoil of reddish-brown gravelly clay loam.

Of the minor soils, the Parrish are the most extensive. The surface layer of these soils is similar to that of Los Gatos soils, but the subsoil is dense, reddish-brown to red gravelly clay.

All areas of this association are used chiefly for wildlife, recreation, and water supply. Some areas of deeper soils on the less steep slopes have been cleared of brush and planted to grass, and these provide forage for livestock and wildlife. On all areas the hazard of erosion is serious if the vegetation is burned off by wildfire.

4. Henneke-Stonyford-Colluvial land association

Very shallow and shallow, well-drained to excessively drained, gravelly, stony, or rocky soils

This soil association consists of several areas along the eastern edge of the mountains. The areas are mainly near Red Mountain, Black Diamond Ridge Lookout, and the lower south-facing slopes of St. John Mountain. Smaller areas are near Fiddlers Green and Euchre Glade. The soils are well drained to excessively drained and are gravelly, stony, or rocky. They are very shallow and shallow over serpentine and metavolcanic rock (greenstone). On the ridgetops the slopes are gently rounded in places, but most slopes are moderately long and are steep to very steep. Elevation ranges from 1,200 feet to 4,000 feet. Rainfall ranges from about 25 inches at lower elevations to more than 40 inches on the higher ridges and peaks. The vegetation consists of semidense to dense stands of brush on the Stonyford and Goulding soils, and generally more open stands of various kinds of shrubs and a few Digger pines on the Henneke soils. This association covers 2.6 percent of the county.

The Henneke soils, the most extensive in this association, account for about 55 percent of the acreage, and the Stonyford soils and Colluvial land, which occupy approximately equal acreages, make up 35 percent of the association. The remaining 10 percent consists of Goulding soils and of small areas of Rock land and of Los Gatos and Maymen soils.

The Henneke soils, on serpentine, are typically shallow and stony. They have a surface layer of thin, reddish-brown gravelly clay loam and a subsoil of dark reddish-brown gravelly clay.

The Stonyford soils, on pillow basalt, generally are shallower than the Henneke soils and are less stony. Their surface layer generally is thin, brown to reddish-brown gravelly heavy loam, and their subsoil generally is reddish-brown, hard gravelly clay loam.

Colluvial land is a mixture of various kinds of soil material and rock fragments.

The minor Goulding soils are shallow over metavolcanic rock and are rocky. These soils have a surface layer of brown very gravelly loam that is slightly acid and a subsoil of similar color and texture. They generally have steep to very steep slopes and are near Colluvial land and Rock land.

All of the soils in this association are better suited to wildlife, water supply, and recreational purposes than to other uses. The vegetation on the areas provides cover and browse for wildlife and protects the soils, which are highly erodible, from erosion. Areas recently burned produce limited forage for livestock and deer. Fire is a hazard during the dry season. Erosion is a serious hazard in areas where the cover has been removed by controlled burning or wildfire.

5. Millsholm-Parrish-Polebar association

Shallow and moderately deep, well-drained, gravelly soils

This soil association consists of three mountainous areas. One is irregular in shape and is near Elephant Hill; another, smaller area, is southeast of Mendocino Pass; and a narrow area is along the lower south-facing slopes of Grindstone Canyon. The soils are shallow and moderately deep, are well drained, and are gravelly. They are underlain by schistose and partly metamorphosed sedimentary rock. The vegetation generally is oaks and grasses, but a few low shrubs and Digger pines make up the vegetation in some areas. Except for Mendocino Pass, which is at an elevation of more than 5,000 feet, elevation ranges from 1,000 to 4,000 feet. Precipitation ranges from 25 inches at the lower elevations to more than 55 inches at elevations of more than 5,000 feet. Snowfall is common at the higher elevations and often remains in protected areas until June. The association makes up 1.8 percent of the county.

The Millsholm and Parrish soils occupy approximately equal acreages and make up about 65 percent of this soil association, and Polebar soils account for about 15 percent. Less extensive areas of Hulls, Montara, Tyson, and Yorkville soils, on various kinds of rock, make up the remaining 20 percent of the area.

Millsholm soils are shallow over schistose and metamorphosed sedimentary rocks. They have a surface layer of thin, pale-brown or brown gravelly loam. The subsoil is similar in texture, but is light yellowish brown.

The parent material of the Parrish soils is similar to that of the Millsholm soils, but Parrish soils are deeper and have a subsoil of reddish-brown gravelly clay.

Polebar soils overlie partly serpentinized sedimentary rock. They have a surface layer and subsoil that are similar in color and texture to those of the Parrish soils, but they are underlain by a distinct horizon that is grayish colored and calcareous.

Of the minor soils, the Yorkville formed from parent material similar to that of the Polebar, but they are somewhat poorly drained and are grayish in color. The Montara soils are well-drained, dark-colored gravelly clays that are shallow over serpentine. Hulls soils, at higher elevations in the Mendocino Pass area, are gray gravelly loams formed in material from mica-chlorite schist. They characteristically feel like talc and have a silvery sheen.

All of the soils of this association are used chiefly as summer range for cattle. They also provide forage for herds of resident and migratory deer and are used for water supply and recreational purposes. The erosion hazard is high. Landslips are common in the Yorkville soils and also occur in many places along roadcuts in areas of Polebar soils.

Soils of the Foothills

The soils of the foothills are in the central part of the county, between the Sacramento Valley and the mountains. They are part of the eastern slope of the Northern Coast Ranges. The areas consist chiefly of rolling to steep hills and of narrow valleys that are drained by intermittent streams. A large area, however, is on a dissected high terrace in the north-central part of the county and along the eastern edge of the foothills.

In the foothills the soils formed mainly in material from hard, unaltered sedimentary rock of the Knoxville formation, and of other formations of the Cretaceous period, and from softly consolidated siltstone of the Tehama formation. Rock crops out in a few places, chiefly on steep hogback ridges. On the terrace the areas consist of poorly sorted gravelly deposits that overlie hard sedimentary rocks of the Knoxville formation and of other formations of the Lower Cretaceous period. The areas are partly dissected as the result of geologic erosion. Except for small, scattered remnants that dip gently to the east, little remains of the original surface of the terrace.

Elevation ranges from 200 to 2,000 feet in most places, but on the terrace it ranges from 250 to 1,500 feet. The average annual rainfall generally is 17 to 25 inches. Grasses and in some places shrubs cover the less humid, lower and south-facing slopes of the foothills. On the higher slopes, where rainfall is more abundant, blue oaks and annual grasses are dominant, though a few Digger pines and shrubs grow in places. On the terrace the vegetation is chiefly grasses or grasses and some blue oaks, scattered Digger pines, and shrubs.

Six of the soil associations in Glenn County are in the foothills.

6. Lodo-Millsholm-Millsap association

Very shallow and shallow, well-drained to excessively drained, shaly and gravelly soils

This soil association forms a narrow area in the foothills that is 2 to 4 miles wide and extends northward from the Colusa County line, near Stony Creek, to the Tehama County line, near Newville. The area consists of smooth, rolling foothills and of prominent, rocky hogback ridges that in places are capped by remnants of high gravelly terraces. Parallel to the many tributaries of Stony Creek, which cut through the area in a generally west to east direction, are narrow, low terraces and stream benches. The soils are well drained to excessively drained and are shaly and gravelly. They are very shallow and shallow over shale and massive conglomerate. Elevation ranges from 600 to 1,800 feet, and the average annual rainfall ranges from 18 to 25 inches. The vegetation is chiefly annual grasses and open stands of blue oaks, but a few Digger pines and shrubs grow in places. Dense stands of chaparral grow in small areas. This association makes up about 4.6 percent of the county.

The Lodo soils account for about 50 percent of the acreage of this association. Millsholm soils make up about 15 percent of the acreage, Millsap soils about 10 percent, and Tehama soils nearly 10 percent. The rest is made up mostly of shaly eroded land, though Arbuckle, Corning, Cortina, Hillgate, Newville, Sehorn, and similar soils that formed in alluvium occupy small areas.

Lodo soils are very shallow over Knoxville shale and are highly erodible. They are rolling to steep and in many places are closely associated with the Tehama or Millsap soils and are mapped in complexes with those soils. Lodo soils are on south-facing slopes and are subject to drying winds.

Millsholm soils are rocky sandy loams that contain much gravel. These soils are on massive, resistant conglomerate that forms the backbone of prominent hogback ridges.

Millsap soils, like the Lodo soils, are on Knoxville shale. They generally are deeper than those soils and have a subsoil of dark-brown clay. They are on steep, more humid, north-facing slopes.

The minor Tehama soils, in concave toe slopes and swales, are very gently sloping. These soils generally are deep and are well drained. Even though these soils are of minor extent, they are important in the association because the forage they produce is of better quality than that produced on the Lodo soils.

Most soils in this association are steep, shallow, or rocky. They are better suited to use as early pasture and range for sheep and cattle than to other uses. A few areas of the Lodo-Tehama complexes are dryfarmed to grain, but yields are low and cultivating such areas increases the erosion hazard. Some areas of this association provide forage for wildlife. Use for deer hunting and other recreation is limited.

7. Millsholm-Sehorn-Contra Costa association

Shallow and moderately deep, mostly well-drained soils

Low foothills and narrow intermittent stream valleys make up this soil association, which is the largest in the county. The most extensive area is 3 to 8 miles wide and extends northward from the Colusa County line, to the Tehama County line, east of Newville. A smaller area lies 2 miles east of the larger area, parallel to Logan Ridge. The soils are shallow and moderately deep over hard, unaltered sedimentary rock and are mostly well drained. Slopes range from rolling to very steep but are chiefly hilly or steep. Elevation ranges from 300 to 2,000 feet, and the average annual rainfall ranges from 20 to

25 inches. At the lower elevations the vegetation is annual grasses and forbs. At the higher elevations where precipitation is greater, blue oaks and annual grasses are the chief kinds of plants, but Digger pines and shrubs grow in a few areas. This association occupies about 13.5 percent of the county.

The Millsholm soils generally are on the more arid south-facing slopes and ridgetops, and the Sehorn and Contra Costa soils occupy the more humid north-facing slopes and toe slopes. The Millsholm soils make up about 40 percent of this association, the Sehorn about 30 percent, and the Contra Costa about 10 percent. The remaining 20 percent consists of small areas of Altamont soils, in the foothills, and of small areas of Hillgate, Myers, Tehama, Yolo, and Zamora soils, in the valleys.

Millsholm soils are pale brown or brown and generally are well drained. These soils are shallow over hard, unaltered conglomerate, sandstone, or shale of the Cretaceous period. They are cherty, gravelly, or rocky or very rocky and range from sandy loam to loam or clay loam in texture. Their texture and color changes little with increasing depth.

Sehorn soils are similar to the Millsholm in color, but they generally are moderately deep and are finer textured. They have a surface layer of silty clay loam, clay loam, or light clay and a subsoil of silty clay or clay.

Contra Costa soils are similar to the Sehorn soils, but they generally have a brown surface layer and a reddish-brown subsoil. This difference in color is because the sandstone and shale material from which the Contra Costa soils formed has a higher iron content than the material from which the Sehorn soils formed.

The soils of this association are used chiefly as pasture and range for sheep and cattle. In places the rolling to hilly areas are dryfarmed to grain in rotation with pasture.

8. *Altamont-Nacimiento association*

Moderately deep, well-drained, calcareous soils

This soil association consists of rolling to steep areas in the foothills and in narrow valleys of intermittent streams. It is made up of several areas in the south-central part of the county. The soils are well drained and calcareous and are moderately deep over hard, unaltered sedimentary rock. Elevations range from 250 to 1,500 feet, and the average annual rainfall is about 20 inches. Annual grasses and forbs are the chief kinds of plants. This association covers about 3.7 percent of the county.

The Altamont and Nacimiento soils make up about 60 percent of this association. About 25 percent of the association consists of the minor Contra Costa and Millsholm soils, and the remaining 15 percent of the minor but less extensive Hillgate, Myers, Yolo, and Zamora soils.

The Altamont and Nacimiento soils are on hard, calcareous sandstone and shale. Altamont soils have a neutral surface layer and a calcareous subsoil, but Nacimiento soils are calcareous throughout.

Near the Altamont and Nacimiento soils are the minor Contra Costa and Millsholm soils, on noncalcareous, sedimentary rock. These soils are slightly acid to neutral. The minor Hillgate, Myers, Yolo, and Zamora soils are in narrow valleys on alluvium.

Some of the highest quality dryland forage in the county is produced on soils of this association. Rolling to hilly areas of the Altamont and Nacimiento soils generally are used for dryfarmed barley in a 3 or 5 year rotation with pasture. In the valleys adequate water for irrigation is lacking, and most of the soils are used for pasture, dryfarmed grain, or hay.

9. *Nacimiento-Altamont-Shedd association*

Moderately deep and deep, well-drained, calcareous soils

Smooth, rolling to hilly soils dissected by narrow valleys of intermittent streams make up this soil association. The soils are along the eastern edge of the foothills in areas that extend from west of Artois southward to the Colusa County line. They are well-drained, calcareous soils that are moderately deep and deep over softly consolidated, calcareous sediments of the Tehama formation. Elevations range from 200 to 1,000 feet, and the average annual rainfall is between 18 and 20 inches. The vegetation is annual grasses and forbs. This association occupies about 3.8 percent of the county.

The Nacimiento soils make up about 40 percent of this association, the Altamont soils about 35 percent, and the Shedd soils about 10 percent. The rest of the acreage consists of the minor Ayar soils and of the minor Arbuckle, Hillgate, Myers, Yolo, Zamora, and other soils on alluvium.

Nacimiento soils are mostly on convex side slopes and hilltops. These deep soils are brownish and are fine textured.

Altamont soils, on concave slopes and saddles, are also deep and fine textured, but they are dark brown in color.

The light brownish-gray Shedd soils occupy areas similar to those occupied by the Nacimiento soils, but they are not so deep nor so fine textured as those soils and are more calcareous.

Of the minor soils, the Ayar soils, on gently undulating to rolling ridgetops, are reddish brown and calcareous. The Arbuckle, Hillgate, Myers, Yolo, Zamora, and other minor soils on alluvium occupy the narrow, dissecting stream valleys in the association.

Most of the acreage in this soil association is held by ranchers. The ranches are large and are used for raising livestock and growing dryfarmed grain, to which the soils are well suited. Yields of grain are high, and the forage produced is among the best in the State. Formerly a limited acreage was used for dryfarmed safflower and sudangrass. Lack of irrigation water and steep slopes limit use of many areas for more intensive farming. When the Tehama-Colusa Canal is completed, water from the Sacramento River will be available for sprinkler irrigation in places on the less steep, lower slopes. These areas can then be farmed more intensively.

10. *Burris-Toomes association*

Deep, somewhat poorly drained, fine-textured, cobbly soils and shallow, well-drained, medium-textured, rocky soils

This soil association is in the foothills in a small acreage surrounding the Orland Buttes. It consists of a gently sloping basalt butte that slopes north and east and is surrounded by moderately steep colluvial slopes. The material on the colluvial slopes is basaltic and over-

lies sedimentary rocks of the Cretaceous period. The soils in this association are deep, somewhat poorly drained, fine textured, and cobbly or are shallow, well drained, medium textured, and rocky. Elevations range from 450 to 1,035 feet, and the average annual rainfall is 17 to 18 inches. Most areas have a cover of grasses and forbs, but blue oaks grow in a few areas on west-facing slopes. This association, the smallest in the county, covers 0.3 percent of the county.

The Burris soils make up about 60 percent of this association, and the Toomes soils about 25 percent. The remaining 15 percent consists of Altamont soils and of Rock outcrop.

Burris soils, on colluvial slopes, are deep, very dark gray or black bouldery or cobbly clays that are somewhat poorly drained.

Toomes soils, on top of the basalt butte, are brown, very rocky or extremely rocky silt loams that are shallow or very shallow over basalt. They are well drained.

All of the soils in this association are too shallow and cobbly or rocky for cultivation. They are used for grazing, and the areas provide lush forage for grazing early in the season.

11. Newville-Corning association

Well-drained, gravelly soils that have a claypan

This soil association is in the foothills on a large, dissected, high terrace in the north-central part of the county and on many smaller remnants of terraces in the Stony Creek Valley between Newville and the Colusa County line. The soils are well drained and gravelly and have a claypan. Slopes are chiefly hilly to steep, but they are nearly level in a few places on remnants of terraces. Elevation ranges from 250 to 1,500 feet, and rainfall ranges from 17 to 25 inches. The native vegetation was mainly annual grasses and forbs, but open to semidense stands of blue oaks grew at the higher elevations and on the more humid north-facing slopes. This association covers about 6.8 percent of the county.

The Newville soils account for about 65 percent of this association, and Corning soils for about 20 percent. The remaining 15 percent consists of the minor Redding and Perkins soils and of minor but smaller areas of Arbuckle, Cortina, and Pleasanton soils.

Newville soils are on dissected slopes below areas of Corning soils. They have a surface layer of brown gravelly loam and a subsoil of reddish-brown gravelly clay. Depth to the claypan ranges from 8 to 20 inches.

Corning soils are on high terrace remnants, and generally have a hummocky microrelief. They are similar to the Newville soils, but generally are redder in color and are more acid. Depth to the claypan ranges from 8 to 22 inches.

The Redding soils are reddish colored and gravelly and have a hardpan, and the Perkins soils are deep and are brown or reddish brown and are gravelly. These minor soils occupy small areas within the association.

Most areas of this association are used for pasture and range. Grain is grown in places on the more gently sloping areas in a 3 or 5 year rotation with pasture. Yields of grain are low because of the limited water-holding capacity of the soils and the low supply of nutrients. In areas that are cultivated or overgrazed, deep gullies are common.

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Soils of Older Alluvial Fans and Low Terraces

Soils of older alluvial fans and low terraces are well drained to somewhat poorly drained and are mostly moderately permeable to very slowly permeable. They occupy areas in valleys in the northern and eastern parts of the county, and make up more than half of the acreage in valleys in the county.

The areas in the northern part of the county are on a sequence of older alluvial fans of Stony Creek. The oldest of these fans was uplifted by geologic action and subsequently was dissected by Stony Creek, leaving many disconnected terrace remnants. On these low terraces are chiefly deep, gravelly or nongravelly soils that have a dense claypan. A slightly younger fan of Stony Creek is south of Orland. This fan spreads out to the southeast, and narrow areas of it extend into basins. Soils on this fan generally have a more uniform profile than those on the other fans.

Along the western edge of the Sacramento Valley, intermittent streams that drain the areas to the west have deposited a series of older alluvial fans. These fans have coalesced into a broad, nearly level to very gently sloping alluvial plain. The fans that form the northern part of this plain consist of material washed from gravelly soils on high terraces. The fans that make up the southern part of the plain consist of material laid down by creeks that drain the foothills. Soils on the northern fans are chiefly coarse textured or medium textured and are gravelly. In places their profile is well developed, and in other places the profile is weakly developed. In contrast, the soils on the southern fans are nongravelly. They are fine textured or have a subsoil of dense clay.

In the southeastern part of the county, the older alluvial sediments were laid down by the Sacramento River on a fan that spreads out on both sides of the channel south of Jacinto. On the upper parts of this fan, the soils are moderately fine textured and are well drained. Along the lower edges of the fan, the soils are fine textured, are somewhat poorly drained or poorly drained, and in many places contain excess salts and alkali.

Five of the soil associations in this county are on older alluvial fans and terraces.

12. Arbuckle-Kimball-Hillgate association

Well-drained, moderately permeable to very slowly permeable soils on low terraces

This soil association is on an older alluvial fan of Stony Creek. The area was slightly uplifted by geologic action and subsequently was dissected by Stony Creek, leaving many, disconnected, low terrace remnants. The largest area is north of Stony Creek and extends eastward from the Calumet District to the Sacramento River. Smaller areas are south and southwest of Orland in the Citrona Park and Emigrant School Districts, north of Ordbend, and west of St. John. The soils are nearly level to very gently undulating and generally overlie schistose and sedimentary rock. They are well drained and are moderately permeable to very slowly permeable. The areas are slightly higher than areas that surround them and are above the level of overflow from Stony Creek. This soil association covers 3.5 percent of the county.

The Arbuckle soils make up about 35 percent of this

association, and the associated Kimball and Hillgate soils make up about 60 percent. The rest of the acreage consists of small areas of the well-drained Tehama soils and of the poorly drained Clear Lake soil.

Arbuckle soils are deep and gravelly and occupy slightly higher areas than the associated Kimball and Hillgate soils.

Kimball soils generally are nongravelly and very slowly permeable. They generally have a surface layer of brown loam and a reddish-brown, very dense claypan subsoil at a shallow depth.

Hillgate soils have a pale-brown surface layer and a brown subsoil, but they are otherwise similar to the Kimball soils. They generally occupy slightly lower areas than the Kimball soils, and runoff from the areas is slower than from the Kimball soils.

Most soils in this association are irrigated, but Arbuckle soils are suited to more crops than the other soils. They are used for alfalfa, almonds, olives, oranges, and many field and forage crops. The Kimball and Hillgate soils are better suited to shallow-rooted crops than to other crops, and large acreages are used for irrigated pasture plants, ladino clover, and milo. Oranges also are grown in places on the Kimball and Hillgate soils, but they require more careful management than when grown on deeper, more permeable soils.

13. Hillgate-Arbuckle-Artois association

Mostly well drained to somewhat poorly drained, moderately permeable to very slowly permeable soils mainly on alluvial fans

This soil association occupies a series of alluvial fans that have coalesced and now form a broad plain. The largest area lies southwest of Orland and west of Artois between areas of the Tehama-Plaza and Newville-Corning soil associations. Smaller areas are near Chrome and along Stony Creek near Tehama County. The alluvium in which the soils formed was washed from gravelly deposits or from hard conglomerate. The soils are nearly level to very gently sloping and are mostly moderately permeable to very slowly permeable. Runoff is slow or very slow. In most places the soils are well drained, but in small depressions they are somewhat poorly drained. The association makes up about 3.8 percent of the county.

The Hillgate soils make up about 33 percent of this association, the Arbuckle about 25 percent, and the Artois about 15 percent. The remaining 27 percent consists mainly of small areas of soils of the Capay, Cortina, Myers, Pleasanton, and Tehama series and of Riverwash.

Hillgate soils generally have a surface layer of pale-brown or brown slightly gravelly or gravelly loam and a subsoil of brown dense clay that is slightly gravelly. These soils are well drained and are slowly permeable to very slowly permeable.

Artois soils are in small depressions where drainage is somewhat poor. They generally have a light brownish-gray surface layer and a yellowish-brown subsoil that characteristically is rust mottled in places, but they are otherwise similar to the Hillgate soils.

Arbuckle soils are brown and gravelly and are well drained. These deep soils generally are on narrow stringers throughout areas of the Hillgate soils or are on low benches that border intermittent streams in the association.

Much of this association is held by ranchers. The ranches are large and are used chiefly for grazing cattle and sheep in rotation with dryfarmed grain. Areas irrigated generally are part of smaller ownerships of less than 64 acres. The chief irrigated crops are pasture plants, ladino clover, milo, and corn, but a limited acreage is used for rice. When the Tehama-Colusa Canal is constructed, adequate irrigation water will be available for development of much of the acreage not now irrigated.

14. Tehama-Plaza association

Deep, well-drained to somewhat poorly drained soils mainly on alluvial fans

This soil association is mainly on old alluvial fans of Stony Creek, south of the present channel of the Creek. The areas are west and south of Orland. They fan out in a general southeast direction in long, narrow areas that extend into basins. The soils are nearly level to very gently undulating. The deposits in which they formed were derived chiefly from schistose and sedimentary rocks. The areas are drained southeastward by shallow sloughs. Runoff is slow, and drainage is good to somewhat poor. The average annual rainfall is 16 to 18 inches. The association covers about 5.7 percent of the county.

The Tehama soils account for about 66 percent of the association, and the Plaza soils for about 20 percent. The remaining 14 percent consists mainly of Arbuckle soils and of less extensive areas of Capay, Clear Lake, Cortina, Hillgate, and Sunnyvale soils.

Tehama soils are well drained. They have a surface layer of pale-brown silt loam or loam and a subsoil of brown clay loam or silty clay loam that is slowly permeable.

Plaza soils are somewhat poorly drained and occupy the lower edges of fans that extend into poorly drained basins. They generally have a light brownish-gray surface layer and a light olive-brown subsoil that is mottled, but they are otherwise similar to the Tehama soils. Also, in places the Plaza soils have a weak hardpan and contain excessive amounts of salts and alkali.

Much of this association is used for dryfarmed barley or as range for sheep. On the Tehama soils the main irrigated crops are almonds, olives, oranges, alfalfa, pasture plants, ladino clover, milo, and corn, but rice is grown in places. Plaza soils are used mostly for rice and for irrigated pasture, ladino clover, corn, milo, and safflower. Rice is not grown on the Arbuckle soils, but these minor soils are used for all other crops grown on the Tehama soils. When the Tehama-Colusa Canal is completed, much of the acreage that is now dryfarmed can be irrigated and used for cultivated crops.

15. Myers-Hillgate association

Well-drained, slowly and very slowly permeable soils mainly on alluvial fans

This soil association borders the eastern edge of the foothills from the Colusa County line northward to near Artois. It is made up of a series of coalescing alluvial fans, derived from sedimentary rock, that slope eastward

from the foothills to the poorly drained areas in basins. The soils are mostly nearly level. A few areas on ridges along streams are very gently sloping, and entrenched drainageways occupy minor areas. Runoff is slow, and some areas are flooded following intensive rainfall. The association makes up about 4.3 percent of the county.

The Myers soils account for about 40 percent of the association, and the Hillgate soils for about 30 percent. The minor Yolo and Zamora soils make up about 20 percent of the association, and small areas of the minor, but less extensive, Artois, Capay, Plaza, and Tehama soils occupy the remaining 10 percent.

Myers soils generally are in areas that are a few feet lower than those occupied by the associated Hillgate soils. They are dark grayish-brown to dark-brown, fine-textured soils that are well drained.

Hillgate soils also are well drained, but they are pale brown to brown and have a claypan.

The minor Yolo and Zamora soils occupy low ridges along creeks that flow through the areas. Yolo soils formed in recent alluvium and are brown and are medium textured or moderately fine textured. Zamora soils are slightly older than Yolo soils and are grayish brown and moderately fine textured.

Most of this soil association is in large ranches used chiefly for grazing in rotation with dryfarmed barley. Because of the lack of a dependable source of water, only a small acreage is irrigated. The main irrigated crops are pasture plants, sugarbeets, milo, and corn. When the Tehama-Colusa Canal is completed, water for irrigation will be available and more of the acreage can be farmed intensively. The Meyers and Hillgate soils are well suited to a variety of field, forage, and row crops. In addition to these crops, the Yolo and Zamora soils are also suited to many tree crops.

16. Zamora-Marvin association

Well-drained to somewhat poorly drained, moderately fine textured and fine textured soils on flood plains

This soil association is on an old flood plain of the Sacramento River. It spreads out on both sides of the river south of Jacinto. Except for low stream ridges that parallel local drainageways, the soils are nearly level. Runoff is slow, and in much of the area the water table is high for part of the year. The alluvium in which the soils formed is from various kinds of rocks. The soil association covers about 4.4 percent of the county.

The Zamora and Marvin soils are about equal in acreage and occupy nearly all of the acreage in this association. A small acreage is occupied by Landlow soils. About 10 percent of the acreage of the Zamora soils, and about 55 percent of that of the Marvin soils, is affected by excess salts and alkali.

Zamora soils are nearest the river and are on low stream ridges that extend into the Marvin soils. They are well drained. Their surface layer is grayish-brown silty clay loam that is slightly acid. The subsoil is similar in color, but it is slightly finer textured and is weakly calcareous.

Marvin soils occupy lower lying areas than the Zamora soils and are moderately well drained or somewhat poorly drained. The areas are between the Zamora soils, on stream ridges, and the edges of the flood plain that border adjacent basins. Marvin soils have a surface layer of grayish-brown silty clay loam or light silty clay that is slightly acid to neutral. The subsoil is dark grayish-brown silty clay that is moderately alkaline and slightly calcareous. The water table is high in the Marvin soils for part of the year.

The Zamora soils are used for a wide variety of irrigated field, forage, row, and orchard crops to which they are well suited. A moderate acreage east of the Sacramento River, however, is used for dryfarmed barley and safflower. The Marvin soils are used mostly for rice, but an acreage east of the Sacramento River is used for dryfarmed barley or as range for sheep and cattle. In areas affected by excess salts and alkali, yields of most crops are lowered. It is difficult to reclaim such areas because they are used to grow rice, which requires a high water table.

Soils of the Basins

The soils of the basins are in the southeastern part of the county. The areas are in the Colusa Basin, south and east of Willows, or are in part of the Butte Basin, east of the Sacramento River.

Soils of the basins are characteristically fine textured and poorly drained. Slopes are nearly level. Runoff is very slow. Most areas that have a high water table are affected by excess salts and alkali.

Three of the soil associations in Glenn County are in the basins.

17. Willows-Capay association

Somewhat poorly drained and poorly drained, fine-textured soils

This soil association extends southward from Willows to the Colusa County line. It is on both sides of the Southern Pacific Railroad in a basin formed between an old stream ridge of Stony Creek, to the east, and alluvial fans of intermittent streams, to the west. The soils are nearly level, are somewhat poorly drained and poorly drained, and are fine textured. They are on alluvium from sedimentary rocks. The water table is high for most of the year, and much of the area is affected by excess salts and alkali. The soil association covers 4.5 percent of the county.

The Willows soils make up about 40 percent of this association, and the Capay soils about 25 percent. The minor Riz soils occupy about 15 percent of the area, and the remaining 20 percent is occupied by the minor, but less extensive, Hillgate, Myers, Yolo, and Zamora soils.

Willows soils have a surface layer of dark grayish-brown clay that is slightly acid or neutral. Their subsoil generally is brown and is moderately alkaline and calcareous. These soils are poorly drained and contain excess salts and alkali.

Capay soils also consist of clay, but they are darker colored than the Willows soils and generally are free of excess salts and alkali. Also, they are somewhat poorly drained.

The minor Riz soils are near the Willows soils but occupy slightly higher areas than those soils. They are poorly drained and are slightly to strongly affected by excess salts and alkali.

The soils in this association are better suited to rice and irrigated pasture than to other uses. Many areas strongly affected by salts and alkali are used for grazing or by members of private clubs for hunting ducks. A large acreage is within the Sacramento National Wildlife Refuge.

18. Willows-Plaza-Castro association

Somewhat poorly drained and poorly drained, medium-textured to fine-textured soils

This soil association is in a depressional area between the flood plain of the Sacramento River, to the east, and alluvial fans of Stony Creek, to the north and west. The areas are in the districts of Bayliss, Codora, and Fairview on alluvium mainly from schistose and partly metamorphosed, sedimentary rock. Except for a few slightly elevated stream ridges and minor drainageways, the soils are nearly level. Runoff is very slow, and the water table is high for much of the year. Cottonwoods and willows grow in a few places in this association along old sloughs. The association covers 3.8 percent of the county.

The Willows soils account for about 40 percent of this association. The Plaza and Castro soils are about equal in area and together make up about 45 percent of the association. The remaining acreage consists mainly of small areas of Sunnyvale soils and of smaller areas of Arbuckle and Tehama soils.

Willows soils are fine textured, poorly drained, and affected by excess salt and alkali. The surface layer is gray and generally is slightly acid or neutral. Below is a grayish-brown subsoil that is moderately alkaline to strongly alkaline and calcareous. The substratum is weakly cemented with lime and silica.

Plaza soils are on alluvial fans that extend into areas of Willows and Castro soils. They are medium textured or moderately fine textured and generally have a light brownish-gray surface layer that is slightly acid. The subsoil generally is light olive brown and is moderately alkaline and calcareous. In many places Plaza soils are affected by excess salts and alkali and have a substratum that is weakly cemented with lime and silica.

Castro soils generally are very dark gray, fine textured, and calcareous and have a layer of nearly white, hardened caliche. They are poorly drained and generally are free of salts and alkali.

The minor Sunnyvale soils have a caliche layer that is not hardened, but they are otherwise similar to the Castro soils.

The soils in this association are better suited to rice than to other crops, though irrigated pasture plants, milo, corn, and safflower are grown in places. Yields are reduced in many areas because of excess salts and alkali.

19. Landlow-Stockton association

Somewhat poorly drained, fine-textured soils that have a hardpan

This soil association occupies a wedge-shaped area between Campbell Slough and Butte Creek, east of the Sacramento River. Except for shallow, dissecting drainageways, the soils are nearly level. The soils in this association formed in alluvium from predominantly basic igneous rock. Elevations range from 60 to 100 feet. A few willows, cottonwoods, and valley oaks grow along the drainageways. The association occupies 2.0 percent of the county.

The Landlow soils make up about 55 percent of this association, and the Stockton soils about 35 percent. The remaining 10 percent consists of small areas of the minor Arbuckle, Corning, and Moda soils.

Landlow soils are dark grayish brown, moderately deep or deep, and have a hardpan that is weakly to strongly cemented with lime and silica.

Stockton soils occupy slightly lower areas than the Landlow soils. They generally are very dark gray and are deep to very deep and have a hardpan only weakly cemented with lime and silica.

The minor soils are all on slightly elevated remnants of terraces and are well drained.

The soils in this association are well suited to rice, and yields are among the highest in the State. Areas not used for rice generally are used for milo, safflower, barley, or irrigated pasture. Some areas of the Stockton soils are subject to overflow from Butte Creek and are used only for grazing.

Soils of the More Recent Alluvial Fans and Flood Plains

Most areas of soils on the more recent alluvial fans and flood plains of the county are along Stony Creek and the Sacramento River, the two major streams in the county.

The more recent alluvial fans of Stony Creek are chiefly in the districts of Orland, Hamilton City, and Ordbend. The sediments in these areas include some wind-deposited material and are slightly older than those on the flood plains. They also lie a few feet above them. Most areas are protected by levees along Stony Creek and are seldom flooded. The soils are medium textured and generally are free of gravel.

The most extensive areas on the recent flood plains are along Stony Creek. This stream and its tributaries drain most of the mountainous areas and the western and northern foothills of the county. It flows north and northeast through the foothills and then southeast across the Sacramento Valley to the Sacramento River. Along its course through the foothills, the flood plain of Stony Creek is narrow and is subject to annual flooding and channel erosion. Upon entering the Sacramento Valley east of the Orland Buttes, the flood plain broadens to a width of about 2 miles and then fingers out into narrow stringers along abandoned channels. Flooding of these downstream areas is now well controlled by Black Butte Dam. The deposits on the flood plains are highly stratified and extremely variable. They consist of gravelly and nongravelly sediments.

The Sacramento River follows a broad, meandering course and frequently shifts its position over the flood plain. Old meander scars are common in the flood plain, and oxbow lakes occupy some of the most recently abandoned channels. Fresh deposits of material are continuously laid down by the river. The soils on these recent deposits are chiefly medium textured, free of gravel, and slightly stratified. Except for a small acre-

age, most of the soils lie within the levee system of the Sacramento River. In places, however, for a few days during periods of peak runoff, the soils develop an intermittent high water table or are flooded.

Three of the soil associations in the county are on the more recent alluvial fans and flood plains of the county.

20. Wyo-Jacinto association

Well-drained to somewhat excessively drained, medium-textured and moderately coarse textured soils on young alluvial fans or on wind-deposited material

Most areas of this soil association are near Orland, Hamilton City, and Ordbend on a series of young alluvial fans of Stony Creek or on stabilized material deposited by wind. Other, less extensive areas are in the foothills on low benches along Stony Creek and its major tributaries. The soils are nearly level to very gently sloping. The material in which they formed was chiefly from schistose and sedimentary rock. The native vegetation was hardwoods and shrubs, but these have been cleared from most areas. The association occupies about 3.3 percent of the county.

The Wyo soils make up about 80 percent of this association, and the Jacinto soils about 10 percent. The remaining 10 percent consists of small areas of Cortina, Orland, and Tehama soils and of narrow areas of Riverwash and Gravelly alluvial land, all of which are intermingled with areas of the Wyo and Jacinto soils.

Wyo soils, on young alluvial fans and stream benches, are grayish brown, deep to very deep, and well drained to somewhat excessively drained. They have a medium-textured surface layer and a slightly finer textured subsoil that is mildly alkaline and intermittently calcareous in the lower part.

Jacinto soils are on stabilized, moderately coarse textured deposits laid down by wind on the south side of old channels of Stony Creek. They are coarser textured than the Wyo soils, and like those soils, have a slightly finer textured subsoil, but they are free of lime.

The soils in this association are well suited to a wide variety of field, forage, and orchard crops, and most areas are cultivated. Yields are high to very high. A traffic pan forms easily in these soils, and in many places such a pan restricts development of roots and penetration of water.

21. Cortina-Orland association

Shallow to deep, well-drained to excessively drained soils on recent alluvial fans and on flood plains

This soil association is on recent alluvial fans and flood plains of Stony Creek. The largest acreage centers on Orland and narrow areas extend from it to the east and south. Smaller areas parallel Stony Creek west of the Orland Buttes, and south of Stony Gorge Reservoir to the Colusa County line. Except for some areas adjacent to Stony Creek, which are dissected by narrow channels, the soils are nearly level to very gently sloping. The soils in this association are shallow to deep over alluvium washed chiefly from areas on schistose and sedimentary rocks. The native vegetation was willows, cottonwoods, valley oaks, and low shrubs and vines in open to semidense stands. The association covers 3.2 percent of the county.

The Cortina soils make up about 45 percent of the association, and the Orland soils about 23 percent. Riverwash occupies an additional 23 percent, and Gravelly alluvial land makes up the remaining 9 percent.

Cortina soils, on flood plains and in channels, are gravelly and are excessively drained. They are shallow to moderately deep over channel sand and gravel.

Orland soils generally are grayish brown, medium textured, and well drained. These soils are shallow to deep over river sand and gravel. They generally occupy small areas on flats or benches that lie a little above the channel of Stony Creek. If the areas are not protected by levees, they are subject to occasional overflow.

Most areas of Cortina soils are used for grazing or are periodically dryfarmed to barley. A small acreage is cultivated and used for irrigated field and orchard crops. The deeper Orland soils are some of the most productive soils in the county and are well suited to a variety of forage, field, and orchard crops. The shallower Orland soils are used mostly for irrigated pasture and alfalfa. Riverwash has little value for farming, but material is mined from some areas for use as railroad ballast or for other industrial use. Because of the severe hazard of flooding and erosion, Gravelly alluvial land is not suited to cultivated crops, though on many ranches the areas have value for grazing.

22. Columbia association

Deep, moderately well drained soils on recent flood plains

This soil association is on flood plains of the Sacramento River. It forms a nearly continuous area, ½ to 2 miles wide, that extends southward from the Tehama County line, near Capay, to the Colusa County line, near Princeton. Old meander scars are common, and oxbow lakes have formed in places in the more recently abandoned channels of the river. These soils overlie recent alluvium derived from various kinds of rocks. The native vegetation was various kinds of hardwoods, shrubs, and vines, but these have been cleared from all but a few low-lying areas that are frequently flooded. Except for a small acreage near Hamilton City, all areas of this association are within the levee system of the Sacramento River. In places periodic flooding is a hazard and a temporary high water table forms during periods of peak runoff. Streambank erosion is a serious problem in a few areas. This association covers 1.8 percent of the county.

The Columbia soils make up about 90 percent of this association, and Riverwash accounts for the remaining 10 percent.

Columbia soils are deep, pale brown, medium textured, and moderately well drained. In places relict mottling occurs below plow depth. The profile is slightly stratified but is otherwise uniform.

The Columbia soils are among the most productive soils in the county. They are well suited to a wide variety of field, truck, forage, and orchard crops, but a considerable acreage is dryfarmed to barley, safflower, milo, and other row crops. Uncleared, low-lying areas that are subject to frequent flooding generally are left idle or are used for grazing.

Descriptions of the Soils

In this section the soil series and the single soils, or mapping units, in each series are described. The description of a soil series mentions features that apply to all soils of that series. Unless otherwise stated the profile described for the series is considered to be representative for all the soils in the series. Differences among the soils of one series are pointed out in the descriptions of the individual soils or are indicated in the soil name.

Following the name of each mapping unit in the descriptions of the soils is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map, which is at the back of the survey. Listed at the end of each description is the capability unit.

For more generalized information about soils in different parts of the county, the reader can refer to the section "General Soil Map." The approximate acreage and proportionate extent of the soils are given in table 1, and a list of the soils mapped, along with the capability unit of each, is given at the back of the survey. More detailed information about the soil series is provided in the sections "Descriptions of Soil Profiles" and "Laboratory Analyses." Definitions of many terms used in describing the soils are in the Glossary.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil symbol	Soil	Acres	Percent	Soil symbol	Soil	Acres	Percent
AaC	Altamont clay, 3 to 15 percent slopes	6,939	0.8	BuD	Burris bouldery clay, 10 to 30 percent slopes	993	0.1
AaA	Altamont clay, 0 to 3 percent slopes	133	(1)				
AaD	Altamont clay, 15 to 30 percent slopes	258	(1)	ByC	Burris cobbly clay, 3 to 15 percent slopes	286	(1)
AaE	Altamont clay, 30 to 50 percent slopes	91	(1)				
AbC	Altamont gravelly clay, 3 to 15 percent slopes	157	(1)	BcB	Burris clay, 1 to 8 percent slopes	311	(1)
				CaA	Capay clay, 0 to 2 percent slopes	11,256	1.3
AcD	Altamont rocky clay loam, 15 to 30 percent slopes	587	(1)	CaB	Capay clay, 2 to 8 percent slopes	1,493	.2
				Cb	Castro clay	5,270	.6
AcE	Altamont rocky clay loam, 30 to 50 percent slopes	507	(1)	Cba	Castro clay, slightly saline-alkali	1,418	.2
				Cbb	Castro clay, moderately saline-alkali	459	(1)
AdE	Altamont soils, 30 to 65 percent slopes	3,962	.5	Cc	Clear Lake clay	4,330	.5
AdC	Altamont soils, 3 to 15 percent slopes	345	(1)	CdsF	Colluvial land, sedimentary rocks	7,683	.9
AdD	Altamont soils, 15 to 30 percent slopes	2,319	.3	CduF	Colluvial land, serpentine rocks	361	(1)
AhC	Altamont-Contra Costa clays, 8 to 15 percent slopes	217	(1)	CdvF	Colluvial land, volcanic rocks	7,304	.9
				ChA	Columbia silt loam, 0 to 2 percent slopes	8,385	1.0
AhD	Altamont-Contra Costa clays, 15 to 30 percent slopes	1,375	.2	ChB	Columbia silt loam, 2 to 8 percent slopes	1,021	.1
AhE	Altamont-Contra Costa clays, 30 to 50 percent slopes	511	(1)	Ck	Columbia silt loam, moderately deep over clay loam, 0 to 1 percent slopes	349	(1)
AfD	Altamont-Gullied land complex, 10 to 30 percent slopes	152	(1)				
AfE	Altamont-Gullied land complex, 30 to 50 percent slopes	838	(1)	Cl	Columbia silt loam, moderately deep over claypan, 0 to 1 percent slopes	90	(1)
AfsD	Altamont-Gullied land complex, shallow, 10 to 30 percent slopes	222	(1)	Cm	Columbia silt loam, moderately deep over gravel, 0 to 2 percent slopes	153	(1)
AfsE	Altamont-Gullied land complex, shallow, 30 to 65 percent slopes	740	(1)	Cn	Columbia silt loam, shallow over clay, 0 to 1 percent slopes	170	(1)
AgE	Altamont-Rocky gullied land complex, 15 to 45 percent slopes	946	.1	Co	Columbia silt loam, shallow over clay, channeled, 0 to 3 percent slopes	380	(1)
AkE3	Altamont and Millsholm soils, 30 to 65 percent slopes, severely eroded	4,502	.5	CpB	Columbia silt loam, water table, 1 to 8 percent slopes	727	(1)
AmC	Altamont-Nacimiento association, 3 to 15 percent slopes	1,118	.1	CeA	Columbia fine sandy loam, 0 to 2 percent slopes	619	(1)
AnC	Altamont-Shedd association, 3 to 15 percent slopes	727	(1)	CeB	Columbia fine sandy loam, 2 to 8 percent slopes	143	(1)
AoA	Arbuckle gravelly loam, 0 to 2 percent slopes	17,200	2.0	Cf	Columbia fine sandy loam, moderately deep over sand and gravel, 0 to 2 percent slopes	54	(1)
AoB	Arbuckle gravelly loam, 2 to 8 percent slopes	1,748	.2	CgA	Columbia loamy fine sand, coarse variant, 0 to 2 percent slopes	184	(1)
Ap	Arbuckle gravelly loam, water table, 0 to 2 percent slopes	1,166	.1	CgB	Columbia loamy fine sand, coarse variant, 2 to 8 percent slopes	31	(1)
Ar	Arbuckle gravelly loam, clayey substratum, 0 to 2 percent slopes	2,160	.3	CrB	Columbia soils, channeled, 0 to 10 percent slopes	1,487	.2
As	Arbuckle gravelly sandy loam, 0 to 2 percent slopes	965	.1	CtE	Contra Costa clay loam, 30 to 65 percent slopes	1,240	.2
AoxA	Arbuckle cobbly loam, 0 to 3 percent slopes	233	(1)	CuE2	Contra Costa clay loam, shallow, 30 to 65 percent slopes, eroded	265	(1)
Av	Artois gravelly loam	1,248	.2				
At	Artois loam	1,720	.2	CsB	Contra Costa clay, shallow, 3 to 8 percent slopes	22	(1)
Au	Artois clay loam	976	.1				
Aw	Artois gravelly clay loam	347	(1)	CvE	Contra Costa-Millsholm clay loams, 30 to 65 percent slopes	7,600	.9
AxC	Ayar clay, 3 to 15 percent slopes	1,174	.1				
AyD	Ayar-Nacimiento clays, 10 to 30 percent slopes	537	(1)	CwB	Corning gravelly loam, 2 to 8 percent slopes	6,263	.7

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil symbol	Soil	Acres	Percent	Soil symbol	Soil	Acres	Percent
CwA	Corning gravelly loam, 0 to 2 percent slopes	2,403	0.3	JaA	Jacinto fine sandy loam, 0 to 2 percent slopes	2,973	0.4
CwxB	Corning-Gullied land complex, 2 to 10 percent slopes	3,013	.4	JaB	Jacinto fine sandy loam, 2 to 8 percent slopes	63	(1)
CxC	Corning-Newville gravelly loams, 3 to 15 percent slopes	692	(1)	JgE	Josephine gravelly loam, 30 to 50 percent slopes	1,187	.1
CyC	Corning-Newville-Gullied land complex, 3 to 15 percent slopes	1,374	.2	JgD2	Josephine gravelly loam, 10 to 30 percent slopes, eroded	65	(1)
CzB	Corning-Redding gravelly loams, 1 to 5 percent slopes	967	.1	JgE2	Josephine gravelly loam, 30 to 50 percent slopes, eroded	278	(1)
Czt	Cortina very gravelly sandy loam, moderately deep	3,833	.5	JmE	Josephine-Maymen gravelly loams, 30 to 50 percent slopes	1,288	.2
Czr	Cortina very gravelly sandy loam	6,670	.8	JsE	Josephine-Sheetiron gravelly loams, 30 to 50 percent slopes	598	(1)
Czs	Cortina very gravelly sandy loam, shallow	363	(1)	Kb	Kimball loam, 0 to 2 percent slopes	5,978	.7
Czh	Cortina gravelly fine sandy loam	191	(1)	KbB	Kimball loam, 2 to 10 percent slopes	529	(1)
Czk	Cortina gravelly fine sandy loam, shallow	2,249	.3	KmA	Kimball gravelly loam, 0 to 2 percent slopes	1,110	.1
Czg	Cortina gravelly loam, water table	69	(1)	KmB	Kimball gravelly loam, 2 to 10 percent slopes	1,428	.2
DuE	Dubakella stony loam, 30 to 50 percent slopes	52	(1)	KnB	Kimball-Gullied land complex, 2 to 10 percent slopes	959	.1
EcB	East Park gravelly clay, 2 to 10 percent slopes	475	(1)	La	Landlow clay	9,269	1.1
EaD	East Park clay, black variant, 10 to 30 percent slopes	9	(1)	Lc	Landlow clay loam	150	(1)
Er	Eroded land, alluvial material	56	(1)	LmD	Lodo-Gullied land complex, 10 to 30 percent slopes	1,841	.2
EsE	Eroded land, shale material	4,394	.5	LmE	Lodo-Gullied land complex, 30 to 50 percent slopes	7,501	.9
GoF	Goulding rocky loam, 50 to 65 percent slopes	1,129	.1	LoD	Lodo-Millsap-Gullied land complex, 1 to 30 percent slopes	145	(1)
GoE	Goulding rocky loam, 30 to 50 percent slopes	349	(1)	LoE	Lodo-Millsap-Gullied land complex, 30 to 65 percent slopes	3,385	.4
Gp	Gravel pits	303	(1)	LsD	Lodo-Tehama clay loams, 10 to 30 percent slopes	1,381	.2
Gr	Gravelly alluvial land	2,937	.4	LsE	Lodo-Tehama clay loams, 30 to 50 percent slopes	424	(1)
HcE	Henneke stony clay loam, 30 to 65 percent slopes	11,210	1.3	LtD	Lodo-Tehama-Gullied land complex, 10 to 30 percent slopes	6,721	.8
HcD	Henneke stony clay loam, 10 to 30 percent slopes	735	(1)	LtE	Lodo-Tehama-Gullied land complex, 30 to 50 percent slopes	720	(1)
HgA	Hillgate loam, 0 to 2 percent slopes	22,923	2.7	LvE	Los Gatos gravelly loam, schist bedrock, 30 to 50 percent slopes	1,425	.2
HgB	Hillgate loam, 2 to 8 percent slopes	2,827	.3	LvD	Los Gatos gravelly loam, schist bedrock, 10 to 30 percent slopes	112	(1)
HhB	Hillgate loam, noderately deep, 0 to 10 percent slopes	195	(1)	LvF	Los Gatos gravelly loam, schist bedrock, 50 to 65 percent slopes	1,233	.1
Hl	Hillgate clay loam, 0 to 3 percent slopes	4,405	.5	LuE	Los Gatos gravelly loam, 30 to 50 percent slopes	1,226	.1
HmA	Hillgate gravelly loam, 0 to 2 percent slopes	3,771	.4	LuF	Los Gatos gravelly loam, 50 to 65 percent slopes	182	(1)
Hn	Hillgate gravelly loam, water table, 0 to 2 percent slopes	184	(1)	LxE	Los Gatos-Josephine gravelly loams, 30 to 50 percent slopes	535	(1)
HmB	Hillgate gravelly loam, 2 to 8 percent slopes	1,730	.2	LyE	Los Gatos-Parrish gravelly loams, 30 to 50 percent slopes	539	(1)
HgxB	Hillgate-Gullied land complex, 2 to 10 percent slopes	2,707	.3	MbA	Marvin silty clay loam, 0 to 2 percent slopes	5,394	.6
HmxB	Hillgate-Gullied land complex, gravelly, 2 to 10 percent slopes	746	(1)	MbB	Marvin silty clay loam, 2 to 10 percent slopes	35	(1)
HhxB	Hillgate-Gullied land complex, moderately deep, 2 to 10 percent slopes	1,019	.1	Mba	Marvin silty clay loam, slightly saline-alkali, 0 to 1 percent slopes	7,896	.9
HoE	Hohmann rocky loam, 30 to 65 percent slopes	655	(1)	Mbb	Marvin silty clay loam, moderately saline-alkali, 0 to 1 percent slopes	730	(1)
HpD	Hohmann rocky loam, deep, 10 to 30 percent slopes	70	(1)	Ma	Marvin silty clay, 0 to 1 percent slopes	2,209	.3
HtE	Hugo loam, moderately deep, 30 to 50 percent slopes	1,674	.2	Maa	Marvin silty clay, slightly saline-alkali, 0 to 1 percent slopes	1,599	.2
HtD	Hugo loam, moderately deep, 10 to 30 percent slopes	282	(1)	Mab	Marvin silty clay, moderately saline-alkali, 0 to 1 percent slopes	48	(1)
HtF	Hugo loam, moderately deep, 50 to 65 percent slopes	185	(1)	MaoB	Marvin silty clay, overflow, 0 to 5 percent slopes	218	(1)
HrE	Hugo loam, 20 to 50 percent slopes	167	(1)	McD	Masterson gravelly loam, 10 to 30 percent slopes	1,926	.2
HuE	Hulls gravelly loam, 30 to 50 percent slopes	1,455	.2				
HuD	Hulls gravelly loam, 10 to 30 percent slopes	220	(1)				
HuF	Hulls gravelly loam, 50 to 65 percent slopes	203	(1)				

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil symbol	Soil	Acres	Percent
McE	Masterson gravelly loam, 30 to 50 percent slopes	973	0.1
MdD	Masterson gravelly loam, moderately deep, 10 to 30 percent slopes	175	(1)
MdE	Masterson gravelly loam, moderately deep, 30 to 50 percent slopes	318	(1)
MdmE	Maymen gravelly loam, schist bedrock, 30 to 65 percent slopes	51,068	6.0
MdkE	Maymen gravelly loam, shallow over schist, 30 to 65 percent slopes	7,250	.9
MdgD	Maymen gravelly loam, 10 to 30 percent slopes	113	(1)
MdgE	Maymen gravelly loam, 30 to 65 percent slopes	1,232	.1
MdoE	Maymen-Los Gatos gravelly loams, 30 to 65 percent slopes	6,348	.8
MdoD	Maymen-Los Gatos gravelly loams, 10 to 30 percent slopes	507	(1)
MdpE	Maymen-Parrish gravelly loams, 30 to 65 percent slopes	2,310	.3
MdpD	Maymen-Parrish gravelly loams, 10 to 30 percent slopes	107	(1)
Me	Maywood loam, shallow over gravel	240	(1)
MfE	Millsap loam, 30 to 50 percent slopes	828	(1)
MfF	Millsap loam, 50 to 65 percent slopes	601	(1)
MnD	Millsholm clay loam, 10 to 30 percent slopes	2,315	.3
MnE	Millsholm clay loam, 30 to 50 percent slopes	1,541	.2
MnE2	Millsholm clay loam, 30 to 65 percent slopes, eroded	924	.1
MlD	Millsholm rocky loam, 10 to 30 percent slopes	564	(1)
MlE	Millsholm rocky loam, 30 to 50 percent slopes	110	(1)
MoD	Millsholm rocky clay loam, 10 to 30 percent slopes	482	(1)
MoE	Millsholm rocky clay loam, 30 to 65 percent slopes	403	(1)
MtD	Millsholm very rocky loam, 15 to 45 percent slopes	279	(1)
MuE	Millsholm very rocky sandy loam, 30 to 65 percent slopes	5,590	.7
MrD	Millsholm rocky sandy loam, 10 to 30 percent slopes	30	(1)
MrE	Millsholm rocky sandy loam, 30 to 50 percent slopes	988	.1
MrE2	Millsholm rocky sandy loam, 30 to 50 percent slopes, eroded	879	.1
MkF	Millsholm gravelly loam, schist bedrock, 50 to 65 percent slopes	2,834	.3
MkE	Millsholm gravelly loam, schist bedrock, 30 to 50 percent slopes	1,725	.2
MgF	Millsholm cherty loam, 50 to 65 percent slopes	147	(1)
MhE	Millsholm gravelly loam, 30 to 50 percent slopes	496	(1)
MhF	Millsholm gravelly loam, 50 to 65 percent slopes	127	(1)
MvE	Millsholm soils, 30 to 50 percent slopes	1,095	.1
MwE2	Millsholm-Contra Costa clay loams, 30 to 50 percent slopes, eroded	5,811	.7
MxE	Millsholm-Contra Costa complex, 30 to 50 percent slopes	302	(1)
MyE2	Millsholm-Lodo complex, 30 to 50 percent slopes, eroded	725	(1)
MmD	Millsholm rocky loam-Gullied land complex, 15 to 30 percent slopes	283	(1)
MmE	Millsholm rocky loam-Gullied land complex, 30 to 65 percent slopes	259	(1)
MngD	Millsholm clay loam-Gullied land complex, 10 to 30 percent slopes	943	.1
MpE	Millsholm rocky clay loam-Gullied land complex, 15 to 50 percent slopes	215	(1)
MsE	Millsholm-Gullied land complex, 30 to 50 percent slopes	790	(1)
Mdw	Mixed alluvial land	190	(1)
Mz	Moda loam	621	(1)
MznE	Montara clay, 20 to 50 percent slopes	137	(1)
MzrA	Myers clay, 0 to 3 percent slopes	18,709	2.2
MzrB	Myers clay, 3 to 10 percent slopes	4,851	.6
MzyA	Myers clay loam, 0 to 3 percent slopes	3,535	.4
MzyB	Myers clay loam, 3 to 8 percent slopes	203	(1)
MzxB	Myers-Gullied land complex, 3 to 10 percent slopes	2,926	.3
NaD	Nacimiento clay, 15 to 30 percent slopes	8,949	1.2
NaC	Nacimiento clay, 3 to 15 percent slopes	620	(1)
NaE	Nacimiento clay, 30 to 50 percent slopes	364	(1)
NcD	Nacimiento soils, 10 to 30 percent slopes	1,454	.2
NcE	Nacimiento soils, 30 to 50 percent slopes	902	.1
NdD	Nacimiento-Gullied land complex, 15 to 30 percent slopes	307	(1)
NdE	Nacimiento-Gullied land complex, 30 to 50 percent slopes	1,423	.2
NgD	Nacimiento-Altamont-Gullied land complex, 15 to 30 percent slopes	474	(1)
NkD	Nacimiento-Contra Costa-Gullied land complex, 15 to 30 percent slopes	829	(1)
NkE	Nacimiento-Contra Costa-Gullied land complex, 30 to 50 percent slopes	1,694	.2
NfD	Nacimiento-Altamont association, 10 to 30 percent slopes	2,801	.3
NhC	Nacimiento-Contra Costa association, 3 to 15 percent slopes	80	(1)
NhD	Nacimiento-Contra Costa association, 15 to 30 percent slopes	3,669	.4
NhE	Nacimiento-Contra Costa association, 30 to 50 percent slopes	1,807	.2
NmE	Neuns cobbly loam, 30 to 50 percent slopes	2,339	.3
NmD	Neuns cobbly loam, 10 to 30 percent slopes	519	(1)
NmF	Neuns cobbly loam, 50 to 65 percent slopes	576	(1)
NnD	Neuns cobbly loam, deep, 10 to 30 percent slopes	469	(1)
NnE	Neuns cobbly loam, deep, 30 to 50 percent slopes	657	(1)
NoD	Neuns cobbly loam, shallow, 10 to 30 percent slopes	129	(1)
NoE	Neuns cobbly loam, shallow, 30 to 50 percent slopes	467	(1)
NvD	Newville gravelly loam, 15 to 30 percent slopes	6,162	.7
NvC	Newville gravelly loam, 3 to 15 percent slopes	2,368	.3
NvE	Newville gravelly loam, 30 to 50 percent slopes	14,293	1.7
NvF2	Newville gravelly loam, 50 to 65 percent slopes, eroded	199	(1)
NwD	Newville-Gullied land complex, 8 to 30 percent slopes	8,147	1.0
NwE	Newville-Gullied land complex, 30 to 50 percent slopes	6,449	.8
NxE	Newville-Lodo-Gullied land complex, 30 to 50 percent slopes	100	(1)

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil symbol	Soil	Acres	Percent
Oa	Orland loam	1,603	0.2
Od	Orland loam, very deep	716	(1)
Odp	Orland loam, deep over claypan	80	(1)
Omp	Orland loam, moderately deep over claypan	120	(1)
Omr	Orland loam, moderately deep over gravel	1,539	.2
Oms	Orland loam, moderately deep over gravelly loam	40	(1)
Osg	Orland loam, shallow over gravel	473	(1)
Osm	Orland loam, shallow over gravelly loam	102	(1)
Owo	Orland loam, shallow over gravel, overflow	586	(1)
Ox	Orland-Cortina complex	497	(1)
PaE	Parrish gravelly loam, 30 to 50 percent slopes	1,109	.1
PbE	Parrish gravelly loam, shallow, 30 to 50 percent slopes	1,249	.2
PbF	Parrish gravelly loam, shallow, 50 to 65 percent slopes	451	(1)
PcD	Parrish-Gullied land complex, 10 to 30 percent slopes	216	(1)
PcE	Parrish-Gullied land complex, 30 to 50 percent slopes	1,313	.2
PdD	Parrish-Yorkville-Gullied land complex, 10 to 30 percent slopes	428	(1)
PdE	Parrish-Yorkville-Gullied land complex, 30 to 50 percent slopes	142	(1)
PeA	Perkins gravelly loam, 0 to 3 percent slopes	1,192	.1
PeC	Perkins gravelly loam, 3 to 15 percent slopes	803	(1)
Pf	Plaza silt loam	7,425	.9
Pfa	Plaza silt loam, slightly saline-alkali	164	(1)
Pg	Plaza silty clay loam	3,668	.4
Pga	Plaza silty clay loam, slightly saline-alkali	1,583	.2
Ph	Plaza silt loam, dense subsoil	1,058	.1
Pha	Plaza silt loam, dense subsoil, slightly saline-alkali	654	(1)
Pk	Plaza silty clay loam, dense subsoil	744	(1)
Pka	Plaza silty clay loam, dense subsoil, slightly saline-alkali	2,643	.3
Pkb	Plaza silty clay loam, dense subsoil, moderately saline-alkali	380	(1)
PmA	Pleasanton gravelly loam, 0 to 2 percent slopes	932	.1
PmB	Pleasanton gravelly loam, 2 to 10 percent slopes	375	(1)
Pn	Pleasanton gravelly sandy clay loam, 0 to 2 percent slopes	170	(1)
Po	Pleasanton very gravelly sandy loam, 0 to 2 percent slopes	232	(1)
PpE	Polebar loam, 30 to 50 percent slopes	979	.1
PrE	Polebar-Gullied land complex, 30 to 50 percent slopes	808	(1)
PsE	Polebar-Millsholm-Gullied land complex, 30 to 50 percent slopes	353	(1)
PtA	Porterville clay, 0 to 2 percent slopes	381	(1)
PtB	Porterville clay, 2 to 10 percent slopes	538	(1)
Rg	Redding gravelly loam, 0 to 3 percent slopes	345	(1)
Rh	Riverwash	9,211	1.1
Rnc	Riz silty clay loam, strongly saline-alkali	3,079	.4
Rnb	Riz silty clay loam, moderately saline-alkali	1,632	.2
Rmb	Riz silt loam, moderately saline-alkali	373	(1)
Rma	Riz silt loam, slightly saline-alkali	847	.1
Rlb	Riz gravelly loam, moderately saline-alkali	95	(1)
RosF	Rock land, sedimentary rocks	753	(1)
RouF	Rock land, serpentine	406	(1)
RovF	Rock land, volcanic rocks	1,763	0.2
RpF	Rock outcrop	298	(1)
Sa	Sacramento clay	288	(1)
SbE	Sehorn soils, 30 to 65 percent slopes	1,816	.2
SbC	Sehorn soils, 3 to 15 percent slopes	290	(1)
SbD	Sehorn soils, 15 to 30 percent slopes	290	(1)
ScD	Sehorn-Gullied land complex, 10 to 30 percent slopes	462	(1)
ScE	Sehorn-Gullied land complex, 30 to 50 percent slopes	593	(1)
SdE	Sehorn-Millsholm association, 30 to 65 percent slopes	38,268	4.5
SdC	Sehorn-Millsholm association, 8 to 15 percent slopes	495	(1)
SdD	Sehorn-Millsholm association, 15 to 30 percent slopes	5,511	.7
SeE	Sehorn-Millsholm-Gullied land complex, 30 to 65 percent slopes	6,738	.8
SeD	Sehorn-Millsholm-Gullied land complex, 15 to 30 percent slopes	2,316	.3
SfC	Shedd silty clay loam, 3 to 15 percent slopes	543	(1)
SfD	Shedd silty clay loam, 15 to 30 percent slopes	1,411	.2
SfE	Shedd silty clay loam, 30 to 50 percent slopes	106	(1)
SgD	Shedd-Altamont association, 10 to 30 percent slopes	2,019	.2
ShC	Shedd-Altamont-Gullied land complex, 8 to 15 percent slopes	98	(1)
SkE	Sheetiron gravelly loam, 30 to 50 percent slopes	6,988	.8
SkD	Sheetiron gravelly loam, 10 to 30 percent slopes	2,703	.3
SkF	Sheetiron gravelly loam, 50 to 65 percent slopes	50,895	6.0
SlD	Sheetiron gravelly loam, shallow, 10 to 30 percent slopes	1,985	.2
SlD2	Sheetiron gravelly loam, shallow, 10 to 30 percent slopes, eroded	614	(1)
SlE	Sheetiron gravelly loam, shallow, 30 to 50 percent slopes	19,858	2.4
SlE2	Sheetiron gravelly loam, shallow, 30 to 50 percent slopes, eroded	806	(1)
SlF	Sheetiron gravelly loam, shallow, 50 to 65 percent slopes	5,951	.7
SlF2	Sheetiron gravelly loam, shallow, 50 to 65 percent slopes, eroded	149	(1)
Sm	Stockton clay	163	(1)
Sn	Stockton clay, moderately deep	1,271	.2
So	Stockton clay, very deep	2,624	.3
Sp	Stockton clay, deep, overflow	329	(1)
Sr	Stockton clay, moderately deep, overflow	223	(1)
Ss	Stockton clay, moderately deep, frequent overflow	912	.1
SuE	Stonyford gravelly clay loam, 20 to 50 percent slopes	1,511	.2
SuE2	Stonyford gravelly clay loam, 20 to 50 percent slopes, eroded	764	(1)
SuF	Stonyford gravelly clay loam, 50 to 65 percent slopes	201	(1)
SuF2	Stonyford gravelly clay loam, 50 to 65 percent slopes, eroded	1,026	.1
StE	Stonyford clay, 30 to 65 percent slopes	98	(1)
SvE	Stonyford-Henneke complex, 30 to 65 percent slopes	232	(1)
Sw	Sunnyvale clay	2,418	.3

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil symbol	Soil	Acres	Percent	Soil symbol	Soil	Acres	Percent
Sxa	Sunnyvale silty clay, slightly saline-alkali	584	(1)	Wdb	Willows clay, dense subsoil, moderately saline-alkali	3,772	0.4
Sy	Sunnyvale silty clay loam	672	(1)	Wdc	Willows clay, dense subsoil, strongly saline-alkali	912	.1
Tm	Tehama silt loam, 0 to 3 percent slopes	30,737	3.6	Wd	Willows clay, dense subsoil	406	(1)
Tb	Tehama loam, deep to gravel, 0 to 3 percent slopes	2,971	.4	Wn	Wyo silt loam	16,329	1.9
Ta	Tehama loam, moderately deep over gravel, 0 to 2 percent slopes	321	(1)	Wg	Wyo loam, deep over gravel	3,888	.5
TcA	Tehama clay loam, 0 to 2 percent slopes	604	(1)	Wh	Wyo gravelly loam, moderately deep over gravel	1,477	.2
TcB	Tehama clay loam, 2 to 10 percent slopes	1,639	.2	Wm	Wyo gravelly clay loam	29	(1)
Tf	Tehama fine sandy loam, 0 to 3 percent slopes	996	.1	Wo	Wyo silt loam, moderately deep over clay	36	(1)
Tg	Tehama gravelly loam, 0 to 3 percent slopes	1,053	.1	Wp	Wyo silt loam, deep over claypan	554	(1)
Th	Tehama gravelly loam, moderately deep over hardpan, 0 to 2 percent slopes	452	(1)	Wsa	Wyo silt loam, slightly saline-alkali	151	(1)
Tk	Tehama gravelly fine sandy loam, moderately deep over gravel, 0 to 2 percent slopes	223	(1)	Wsw	Wyo silt loam, water table	161	(1)
Tn	Tehama silt loam, water table, 0 to 2 percent slopes	199	(1)	Yc	Yolo clay loam	864	.1
ToB	Tehama-Gullied land complex, 2 to 10 percent slopes	1,186	.1	Yd	Yolo clay loam, moderately deep over clay	1,730	.2
TpF	Terrace escarpments	971	.1	Yf	Yolo clay loam, deep over claypan	180	(1)
TsC	Toomes extremely rocky silt loam, 5 to 30 percent slopes	333	(1)	Yg	Yolo clay loam, moderately deep over hardpan	25	(1)
TrD	Toomes very rocky silt loam, 10 to 30 percent slopes	245	(1)	Yh	Yolo clay loam, shallow over clay	1,809	.2
TtE	Tyson gravelly loam, 30 to 50 percent slopes	910	.1	Yma	Yolo clay loam, slightly saline-alkali	251	(1)
TvE2	Tyson gravelly loam, shallow, 30 to 50 percent slopes, eroded	756	(1)	Yo	Yolo silt loam, silty clay loam substratum	309	(1)
TvF2	Tyson gravelly loam, shallow, 50 to 65 percent slopes, eroded	13	(1)	YvE	Yorkville clay loam, 30 to 65 percent slopes	279	(1)
TuD	Tyson gravelly loam, deep, 10 to 30 percent slopes	278	(1)	ZbA	Zamora silty clay loam, 0 to 2 percent slopes	21,600	2.6
TuE	Tyson gravelly loam, deep, 30 to 50 percent slopes	88	(1)	Za	Zamora silty clay, 0 to 2 percent slopes	711	(1)
Wcb	Willows clay, moderately saline-alkali	5,175	.6	ZbB	Zamora silty clay loam, 2 to 8 percent slopes	3,469	.4
Wca	Willows clay, slightly saline-alkali	7,433	.9	Zc	Zamora silty clay loam, deep over hardpan, 0 to 2 percent slopes	156	(1)
Wcc	Willows clay, strongly saline-alkali	1,747	.2	Zd	Zamora silty clay loam, deep over silty clay, 0 to 2 percent slopes	1,090	.1
Wda	Willows clay, dense subsoil, slightly saline-alkali	7,548	.9	Zma	Zamora silty clay loam, slightly saline-alkali, 0 to 2 percent slopes	1,284	.2
				Zmb	Zamora silty clay loam, moderately saline-alkali, 0 to 2 percent slopes	484	(1)
					Intermittent ponds	3,221	.4
					Water (lakes, rivers, reservoirs, and so on)	5,109	.6
					Miscellaneous (towns, landing fields, and so on)	1,143	.1
					Total	846,080	100.0

[1] Less than 0.1 percent.

Altamont Series

The Altamont series consists of nearly level to very steep, moderately deep or deep, well-drained soils. These soils formed under annual grasses and forbs in material from hard, interbedded sandstone and shale or from softly consolidated siltstone. They are in the central foothills of the county at elevations of 250 to 2,000 feet. The average annual rainfall is 18 to 25 inches.

The surface layer is brown or dark-brown heavy clay loam or clay that is slightly acid to neutral. It typically is leached of lime. The subsoil is brown, pale-brown, light olive-brown, or light reddish-brown clay that is mildly alkaline to moderately alkaline and is calcareous in the lower part. The content of lime in the subsoil varies, but it rarely is more than 10 percent of a horizon.

These soils are near the Millsholm, Contra Costa, and Sehorn soils, which are shallow and moderately deep and are noncalcareous. In many places they are closely associated with the calcareous Nacimiento and Shedd soils and are mapped in complexes with those soils.

Altamont soils are used for grazing and dryfarmed grain. They are among the best soils in the county for sheep and cattle range and produce annual forage of high quality.

Altamont clay, 3 to 15 percent slopes (AaC).—This deep soil formed in material from softly consolidated beds of siltstone of the Tehama formation. It generally is in the low foothills west of Willows and Artois and near the calcareous Nacimiento and Shedd soils and the gravelly Newville soils. Areas adjacent to the Newville soils generally have cobblestones in places on the surface.

Representative profile:

0 to 18 inches, dark-brown, very hard clay that is dark brown and very firm when moist; a few cobblestones on the surface; structure is granular in the uppermost 1 inch,

but very coarse, prismatic and coarse, angular blocky below; slightly acid to neutral.
18 to 29 inches, brown, very hard clay that is dark brown and very firm when moist; coarse, angular blocky structure; contains finely disseminated lime; mildly alkaline and slightly calcareous.
29 to 43 inches, brown to strong-brown, very hard clay that is dark brown and very firm when moist; contains both finely disseminated lime and segregated lime in small, hard nodules and soft concretions; mildly alkaline and strongly calcareous.
43 inches +, mottled, pale-yellow and light yellowish-brown softly consolidated siltstone that is light yellowish brown and light olive brown when moist; contains seams and soft concretions of lime; mildly alkaline and calcareous.

The surface layer ranges from dark brown or brown to strong brown or light reddish brown, and the subsoil ranges from brown or strong brown to reddish brown. Texture of the profile is clay thoughout. In some places a few cobblestones are on the surface and a few pebbles are scattered throughout the profile.

The surface layer is slightly acid to neutral. The subsoil is mildly alkaline to moderately alkaline and is slightly calcareous to strongly calcareous. It contains lime that is finely disseminated and segregated in hard nodules and soft concretions. Depth to the lime varies but generally is within a depth of 15 to 25 inches. Softly consolidated parent material generally is at a depth of 35 to 55 inches.

Permeability of this soil is slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Root penetration is deep to very deep, and the available moisture holding capacity is 7 to 10 inches. Fertility is high.

This soil is used for pasture and range and for dryfarmed grain, sudangrass, and safflower. On most areas wild oats, soft chess, and burclover are dominant, but on some areas medusahead, an undesirable annual grass, has invaded. Capability unit IIIe–5.

Altamont clay, 0 to 3 percent slopes (AcA).—On this deep soil runoff is slow, and the erosion hazard is slight. Most of this soil is in the low foothills, but a few small areas are on low terraces in the northeastern part of the county near the Kimball and Arbuckle soils.

Areas of this Altamont soil are used for range and dryfarmed grain or hay. Capability unit IIIs–5.

Altamont clay, 15 to 30 percent slopes (AcD).—Runoff on this soil is medium. The erosion hazard is moderate. A few areas are near the Newville soils, and in a few places these areas have some cobblestones on the surface.

This Altamont soil is used as range for sheep and cattle and for dryfarmed grain or hay. Capability unit IVe–5.

Altamont clay, 30 to 50 percent slopes (AcE).—Runoff is rapid on this deep soil, and the erosion hazard is severe. This soil is too steep to cultivate and is therefore used for range and pasture. Capability unit VIe–5.

Altamont gravelly clay, 3 to 15 percent slopes (AbC).—This soil is 15 to 25 percent gravel throughout. A few float cobblestones that are 3 to 8 inches in diameter are on the surface in some areas. The available water capacity is 5 to 8 inches. Runoff is slow to medium, and the erosion hazard is slight to moderate.

Most of this soil is along the eastern edge of foothills southwest of Willows. The acreage is small and is used for range and dryfarmed barley. Capability unit IIIe–5.

Altamont rocky clay loam, 15 to 30 percent slopes (AcD).—This soil is in the foothills. It is shallower than Altamont clay, 3 to 15 percent slopes. Depth to sandstone and shale parent material generally is 20 to 28 inches, but it is only 15 inches in some areas. Rock outcrops make up 2 to 10 percent of the surface. The available moisture holding capacity is 3 to 5 inches. Runoff is medium, and the erosion hazard is moderate.

Tilling this soil is impractical because of the rock outcrops, and the areas are therefore used for range. Capability unit VIs–8.

Altamont rocky clay loam, 30 to 50 percent slopes (AcE).—On this soil runoff is rapid, and the erosion hazard is severe. All areas are used for range. Capability unit VIs–8.

Altamont soils, 30 to 65 percent slopes (AdE).—This mapping unit consists of soils that formed in material from hard, calcareous sandstone and shale of the Cretaceous period. From 50 to 80 percent of the unit is Altamont clay, and the rest is Altamont clay loam. The Altamont clay is on concave toe slopes and moist north-facing slopes. It is clay throughout and is moderately deep to deep. Depth to bedrock generally is 30 to 40 inches. The Altamont clay loam is on convex ridgetops and drier south-facing slopes. Its surface layer is heavy clay loam 4 to 6 inches thick, and depth to bedrock generally is 24 to 32 inches, but it is otherwise similar to the Altamont clay described in the profile that follows.

Representative profile of Altamont clay:

0 to 20 inches, brown, very hard clay that is dark brown and firm when moist; coarse, granular structure in the upper 1 to 2 inches, but strong, very coarse, prismatic and moderate, coarse to very coarse, blocky structure below; neutral in the upper part but mildly alkaline with increasing depth.
20 to 26 inches, brown, very hard clay that is dark brown and firm when moist; a few shale fragments; coarse, blocky structure; mildly alkaline and slightly calcareous; contains lime that is mostly segregated in soft concretions.
26 to 34 inches, light olive-brown to brown, hard, shaly clay that is olive brown to dark brown and firm when moist; massive; mildly alkaline and strongly calcareous; contains lime that is finely disseminated and also is segregated in soft concretions and hard nodules.
34 inches +, hard, fractured, fine-grained sandstone and shale; strongly calcareous; contains lime that is concentrated mostly in whitish seams along fracture planes.

The surface layer ranges from brown or dark brown to grayish brown, and the subsoil from brown or yellowish brown to light olive brown. In texture the profile is clay throughout, but varying amounts of shale fragments are in the lower subsoil just above the parent material. Depth to bedrock ranges from 25 to 50 inches but generally is 30 to 40 inches. Rock outcrops are rare. Depth to lime generally is 15 to 24 inches, but in some moist sites it is as much as 30 to 36 inches. In eroded areas lime is within a few inches of the surface.

These Altamont soils are slowly permeable. Runoff is rapid to very rapid, and the erosion hazard is severe. Root penetration is moderately deep to deep, and available moisture holding capacity is 4 to 7 inches. Fertility is high.

The soils of this mapping unit are too steep to cultivate. They are used only for range or pasture. On most areas wild oats, soft chess, and burclover are predominant, but on some areas medusahead, an undesirable annual grass, has invaded. Capability unit VIIe–5.

Altamont soils, 3 to 15 percent slopes (AdC).—On these soils, runoff is slow to medium and the erosion hazard is slight to moderate. These soils are used for range and dryfarmed grain. Capability unit IIIe–5.

Altamont soils, 15 to 30 percent slopes (AdD).—Runoff on soils in this unit is medium. The erosion hazard is moderate. Rocks crop out in a few places.

These soils are used for range and dryfarmed grain. Capability unit IVe–5.

Altamont-Contra Costa clays, 8 to 15 percent slopes (AhC).—This complex is in the foothills near Squaw Flat. From 60 to 75 percent of the complex is Altamont clay, on convex slopes, and the rest is Contra Costa clay, in concave slopes and on saddles. The Altamont clay is similar to the clay soil in Altamont soils, 3 to 15 percent slopes. The Contra Costa clay generally is 30 to 45 inches deep to sandstone and shale bedrock, but it is otherwise similar to Contra Costa clay, shallow, 3 to 8 percent slopes.

These soils generally are dryfarmed to barley in a 3- to 5-year rotation. Capability unit IIIe–5.

Altamont-Contra Costa clays, 15 to 30 percent slopes (AhD).—This mapping unit is in the south-central foothills of the county. It is on moderately steep foothills, but it is otherwise similar to Altamont-Contra Costa clays, 8 to 15 percent slopes. Runoff is medium, and the erosion hazard is moderate.

These soils are used for range and for dryfarmed grain or hay. Capability unit IVe–5.

Altamont-Contra Costa clays, 30 to 50 percent slopes (AhE).—These soils are in the south-central foothills of the county near other soils of the Altamont and Contra Costa series and near soils of the Nacimiento series. Runoff is rapid, and the erosion hazard is severe.

These soils are too steep to cultivate and are used only for range. Capability unit VIe–5.

Altamont-Gullied land complex, 10 to 30 percent slopes (AfD).—This unit consists of Altamont clay, 3 to 15 percent slopes, and Altamont clay, 15 to 30 percent slopes, that are cut by gullies. The gullies are 4 to 6 feet deep and are at intervals of 500 to 1,000 feet. Runoff is medium, and the erosion hazard is moderate.

This complex is used chiefly for range and for dryfarmed barley. Because the gullies are too deep to cross with farm machinery, tillage is costly. Capability unit IVe–5.

Altamont-Gullied land complex, 30 to 50 percent slopes (AfE).—This complex consists of Altamont clay, 30 to 50 percent slopes, that is cut by deep gullies. The gullies are at intervals of 500 to 1,000 feet. Many areas are on side slopes just below Newville soils and in places have some pebbles and cobblestones on the surface.

This complex is used only for range. Capability unit VIe–5.

Altamont-Gullied land complex, shallow, 10 to 30 percent slopes (AfsD).—This complex is in the foothills. It consists of Altamount clay and clay loam that are cut by gullies. The gullies are 3 to 5 feet deep and are at intervals of 500 to 1,000 feet. Depth to bedrock generally is 18 to 28 inches. In places rock outcrops occupy nearly 2 percent of the surface.

The soils of this complex are used for range and for dryfarmed grain or hay. Because of the gullies it is difficult to till these soils and to harvest crops from the areas. Capability unit IVe–5.

Altamont-Gullied land complex, shallow, 30 to 65 percent slopes (AfsE).—This complex consists of Altamont soils 30 to 65 percent slopes, that are underlain by sandstone and shale at a depth of 15 to 30 inches. The areas are cut by gullies 3 to 5 feet deep at intervals of 500 to 1,000 feet.

All of this complex is used for range or pasture. Capability unit VIIe–5.

Altamont-Rocky gullied land complex, 15 to 45 percent slopes (AgE).—This complex consists of Altamont rocky clay loam on 10 to 30 percent slopes, and Altamont rocky clay loam, 30 to 50 percent slopes, that are cut by gullies. The gullies are 2 to 5 feet deep and are at intervals of 500 to 1,000 feet. Runoff is slow to rapid, and the erosion hazard is moderate to severe.

All of this complex is used as range for sheep and cattle. In many places the gullies are difficult for stock to cross and grazing is hindered. Capability unit VIs–8.

Altamont and Millsholm soils, 30 to 65 percent slopes, severely eroded (AkE3).—This mapping unit consists of severely eroded Altamont and Millsholm soils on south-facing slopes. The largest areas overlie layers of nearly horizontal rock. Most of the original soil material has been washed away, and the present soil material is only 4 to 10 inches thick over hard sandstone and shale. Most areas are cobbly or stony and rocks crop out on them. Runoff is very rapid, and the erosion hazard is very severe. The water-holding capacity is less than 2 inches. Drainage is excessive, and root penetration is very shallow.

These soils have only sparse stands of annual grasses and forbs on them, and their use for range or pasture is limited. The steep slopes and severe erosion hinder grazing, and livestock therefore generally graze these soils on parallel trails perpendicular to the slope. Capability unit VIIs–8.

Altamont-Nacimiento association, 3 to 15 percent slopes (AmC).—From 50 to 75 percent of this mapping unit is Altamont clay, 3 to 15 percent slopes, and the remainder is Nacimiento clay, 3 to 15 percent slopes. The Altamont soil occupies the long, less steep concave slopes, and the Nacimiento soil generally occupies the short, gently sloping to moderately steep convex slopes. In some places a few deep gullies are in the Altamont soil.

Most of this mapping unit is used for range and for dryfarmed barley. Safflower and sudangrass have been grown on a small acreage. Capability unit IIIe–5.

Altamont-Shedd association, 3 to 15 percent slopes (AnC).—From 50 to 75 percent of this mapping unit consists of Altamont clay, 3 to 15 percent slopes, and the remainder is mostly Shedd silty clay loam, 3 to 15 percent slopes. The Altamont soil is on concave toe slopes and in swales, and the Shedd soil is on convex slopes.

Included with these soils are small areas of Nacimiento and Newville soils.

Altamont-Shedd association, 3 to 15 percent slopes, is used for range and dryfarmed grain or hay. Capability unit IIIe–5.

Arbuckle Series

The Arbuckle series consists of nearly level to very gently sloping, deep, well-drained soils that are gravelly.

These soils formed in unconsolidated alluvium derived mainly from conglomerate, old gravelly deposits on terraces, and metamorphosed sedimentary rock. They are on alluvial fans, benches, and low terraces in the Sacramento Valley and in the foothills of the county at elevations of 100 to 1,200 feet. The average annual precipitation is 15 to 25 inches. The vegetation is chiefly annual grasses and forbs but includes scattered blue oaks.

These soils have a surface layer of brown gravelly sandy loam or loam that is slightly acid to medium acid. The subsoil is brown, near reddish-brown gravelly loam or light clay loam and is medium acid to neutral. The gravel is mainly white quartzite and multicolored chert less than one-half inch in diameter. It generally increases in amount with increasing depth. In a few areas cobblestones as much as 6 inches in diameter are common in the surface soil and subsoil.

In the Sacramento Valley the Arbuckle soils are near the Artois, Hillgate, and Kimball soils, which have a claypan, and the Tehama soils, which lack gravel. In the foothills Arbuckle soils are on low benches along intermittent streams that drain areas of Corning and Newville soils, which are gravelly and have a claypan.

Arbuckle soils are used for many irrigated row crops, field crops, and orchard crops that are suited to the climate. They are also used for dryfarmed barley and range.

Arbuckle gravelly loam, 0 to 2 percent slopes (AoA).—This soil is in the northeastern part of the county and makes up about 75 percent of the Arbuckle soils mapped in the county. The areas are irregular in shape and range from less than 5 to more than 2,000 acres in size.

Representative profile:

0 to 13 inches, brown, hard gravelly loam that is dark brown and friable when moist; the gravel is mainly quartzite and varicolored chert; massive; medium acid.
13 to 21 inches, similar to the horizon just above, except the color has a slight reddish tinge; massive; medium acid.
21 to 32 inches, brown, very hard heavy gravelly loam that is dark brown, near dark reddish brown, and firm when moist; massive; medium acid.
32 to 60 inches +, color and texture similar to that of the horizon just above, except gravel is more numerous and is slightly larger in size; massive; medium acid but becomes neutral with increasing depth.

The surface layer is gravelly loam or gravelly fine sandy loam and is as much as 15 to 30 percent gravel, by volume. Its color in many places is pale brown or brown and has a slight reddish cast. In uncultivated areas the uppermost 1 inch of the surface layer has weak, platy structure in many places. The subsoil is generally slightly redder than the surface soil and ranges in texture from gravelly loam to gravelly light clay loam. The substratum is gravelly or very gravelly loam or fine sandy loam and is brown, pale brown, or light yellowish brown. The surface layer is slightly acid to medium acid, and the subsoil and substratum are near neutral to medium acid.

Permeability of this soil is moderate. Runoff is slow, and the erosion hazard is slight. The available water holding capacity is 6 to 8 inches. This soil holds less water than soils that are not gravelly, and it therefore requires more frequent irrigation than those soils and the irrigation runs must be shorter.

Irrigated crops, such as alfalfa, milo, corn, ladino clover, pasture plants, olives, prunes, almonds, and oranges (fig. 2) are grown on this soil. Areas that are not irrigated generally are dryfarmed to barley or are used as early range for sheep and cattle. Capability unit IIs–4.

Arbuckle gravelly loam, 2 to 8 percent slopes (AoB).—This soil is mainly near Newville and Elk Creek, and along St. John Trail near the Colusa County line on small, very gently sloping alluvial fans and benches. Smaller areas are in the district of Capay on low mounds and long, narrow ridges. Runoff is slow to medium, and the erosion hazard is slight. Gullies 4 to 6 feet deep are in a few areas.

This soil is used for dryfarmed grain and range. Most areas are poorly located or are too small for economical irrigation. Capability unit IIe–4.

Arbuckle gravelly loam, water table, 0 to 2 percent slopes (Ap).—This soil is on low knolls on narrow alluvial fans that extend into poorly drained basins. The water table generally is within 3 feet of the surface during the ricegrowing season, but when the water is removed from the ricefields, the water table drops to a depth below 5 feet.

This soil is used mainly for irrigated pasture, milo, and corn, but alfalfa is grown in some places. A few areas have been leveled and are farmed to rice along with the associated Plaza and Willows soils. Because areas of this soil are on knolls that are slightly higher than other surrounding soils, they are used for homesites and equipment yards in many places. Capability unit IIIw–3.

Arbuckle gravelly loam, clayey substratum, 0 to 2 percent slopes (Ar).—This soil has a fairly impervious substratum of clay or siltstone at a depth of 5 feet or more. It is mainly along minor streams that drain the dissected high terraces and extend into areas of old alluvial fans west of Orland.

Included with this soil are small areas of Riverwash and of Cortina soils.

This Arbuckle soil is moderately permeable in the upper part, but the substratum is very slowly permeable to water and restricts development of deep-rooted plants. An intermittent high water table develops during the wet winter months and during the irrigation season when excess water is diverted into the natural drainageways.

Because of the intermittent high water table, this soil is better suited to barley, corn, milo, pasture plants, ladino clover, and similar shallow-rooted, irrigated field and row crops than to other crops. In places alfalfa and a few almonds and olives are grown on this soil, but these crops are highly susceptible to root rot because of the poor drainage in the subsoil. In many places, and especially along creeks in the dissected terraces, areas of this soil are too narrow or small for irrigation. These areas are used for pasture or dryfarmed grain. Capability unit IIIs–3.

Arbuckle gravelly sandy loam, 0 to 2 percent slopes (As).—This soil has a surface layer of gravelly sandy loam but otherwise is similar to Arbuckle gravelly loam, 0 to 2 percent slopes. Permeability is moderate to moderately rapid. Runoff is very slow, and erosion is not a hazard. The available water holding capacity is 5 to 7 inches.

The same kinds of crops are grown on this soil as on Arbuckle gravelly loam, 0 to 2 percent slopes. Capability unit IIs–4.

Figure 2.—**Oranges on Arbuckle gravelly loam, 0 to 2 percent slopes, in the area near Orland, Hamilton City, and Ordbend.**

Arbuckle cobbly loam, 0 to 3 percent slopes (AoxA).—This soil occupies a small area north of Stonyford and a less extensive area along Heifer Camp Creek northwest of Chrome. As much as 30 to 50 percent of the soil material, by volume, is gravel and cobblestones. Runoff is slow, and the erosion hazard is slight. Permeability is moderate to moderately rapid, and the available water holding capacity is 4 to 5 inches.

Gravel and cobblestones make it difficult to cultivate this soil. The soil is probably better suited to dryland range than to other uses. Irrigated pasture plants, milo, and corn are also grown. Capability unit IIIs–4.

Artois Series

In the Artois series are nearly level to very gently sloping, moderately well drained soils that have a claypan. These soils formed under annual grasses and forbs in alluvium from sedimentary rock and from gravelly deposits on terraces. The alluvium is somewhat gravelly and is poorly sorted. These soils are on old alluvial fans of intermittent streams, mainly west and northwest of Artois at elevations of 150 to 400 feet. The average annual rainfall is 16 to 18 inches.

The surface layer generally is light brownish-gray or grayish-brown slightly gravelly or gravelly loam or clay loam that is slightly acid. Below is yellowish-brown or olive-brown clay that is neutral to mildly alkaline. Rust-brown mottles are common in the lower part of the surface soil and in the upper part of the subsoil.

Artois soils are in the same general area as the Arbuckle and Hillgate. In many places they are near narrow stringers of gravelly Cortina soils and small areas of fine-textured Capay soils in depressions.

All of the Artois soils have been cultivated. Pasture plants, milo, corn, ladino clover, red clover, and rice are the chief irrigated crops. Areas not irrigated are dry-farmed to grain or used as range for sheep.

Artois gravelly loam (0 to 2 percent slopes) (Av).—This nearly level soil is west of Artois on old alluvial fans of Walker, Wilson, White Cabin, Sheep Corral, and French Creeks.

Representative profile:

0 to 17 inches, light brownish-gray, hard gravelly loam to light clay loam that is dark brownish gray and friable when moist; the gravel is mainly white quartzite and multicolored chert; strong-brown mottles are in the lower part; massive; slightly acid.

17 to 21 inches, olive-brown to grayish-brown, very hard gravelly light clay that is very dark grayish brown and very firm when moist; a few strong-brown mottles; massive or weak, blocky structure; a few small manganese pellets; slightly acid.

21 to 60 inches +, yellowish-brown to pale-brown, very hard slightly gravelly clay that is dark brown and very firm when moist; very coarse, subangular blocky structure, but massive with increasing depth; a few manganese pellets; neutral, but mildly alkaline with increasing depth.

The surface layer ranges from pale brown to grayish brown but typically is light brownish gray. The subsoil ranges from pale brown or brown to olive, but it generally is yellowish brown or light olive brown. In the

surface layer gravel makes up 15 to 30 percent of the soil mass, by volume. The gravel in the subsoil is more variable than that in the surface layer and makes up 2 to 20 percent of the soil mass. Rust mottles and pellets of manganese are mainly in the lower part of the surface layer and subsoil, but in places in ricefields, they are throughout the profile. The surface layer is medium acid to slightly acid. Acidity decreases with increasing depth, and the lower part of the subsoil is neutral or is mildly alkaline.

This soil is moderately well drained. Permeability is slow. Runoff also is slow, and erosion is not a hazard. The available water holding capacity is 6 to 8 inches. In most places depth of root penetration is within the surface layer, but in a few places roots penetrate into the upper part of the subsoil. Fertility is moderate.

Artois gravelly loam is used chiefly for dryfarmed grain and as pasture for sheep. The irrigated crops are pasture plants, ladino clover, milo, corn, and safflower. Some areas have been planted to rice, but lack of cheap irrigation water restricts use of these soils for rice. Capability unit IIIs-3.

Artois loam (0 to 2 percent slopes) (At).—This soil, the most extensive of the Artois soils, is nearly free of gravel, but it is otherwise similar to Artois gravelly loam. The available moisture holding capacity is 7 to 10 inches.

Included with this soil are small areas of Arbuckle soils and of other Artois soils.

Much of this Artois soil is used as pasture for sheep in rotation with dryfarmed barley. If irrigation water from wells is available, ladino clover, milo, corn, safflower, and pasture plants generally are grown. Capability unit IIIs–3.

Artois clay loam (0 to 2 percent slopes) (Au).—This soil generally is in small depressional areas. Water drains more slowly from areas of this soil than from Artois loam. Also the surface layer generally is grayish brown and mottles generally are higher in the profile.

This soil is used for the same crops that generally are grown on Artois loam. Much of the acreage is dryfarmed to barley or used as pasture for sheep. If water for irrigation were available from wells, or canals, this soil would be well suited to irrigated, shallow-rooted field and forage crops. Capability unit IIIs–3.

Artois gravelly clay loam (0 to 2 percent slopes) (Aw).—The surface layer of this soil is finer textured and somewhat darker colored than that in Artois gravelly loam, but the two soils are otherwise similar. Also this soil generally is more slowly drained and occupies areas bordering small basins made up of Capay soils.

In irrigated areas pasture plants, ladino clover, milo, corn, and safflower are grown. In dryfarmed areas barley is grown in rotation with pasture for sheep. Capability unit IIIs–3.

Ayar Series

In the Ayar series are well-drained, fine-textured, calcareous soils on smooth, gently undulating to rolling ridgetops. These soils formed under annual grasses and forbs in material from softly consolidated sediments of the Tehama formation. They are in the foothills in the east-central part of the county at elevations of 250 to 900 feet. The average annual rainfall is 17 to 20 inches.

The surface layer is brown or reddish-brown, mildly alkaline, calcareous clay. The subsoil is similar in color and texture, but it is extremely calcareous. It abruptly overlies a layer of white, hardened caliche at a depth of 30 to 50 inches. When dry, the structure in the surface soil is of the kind characteristic of adobe soils, and deep cracks form in it and extend into the subsoil.

These soils are chiefly associated with soils of the Altamont and Nacimiento series.

Ayar soils are used for grazing and dryfarmed grain or safflower. They are among the best soils in the county for range and produce forage for sheep and cattle that is of high quality.

Ayar clay, 3 to 15 percent slopes (AxC).—This moderately deep to deep soil is on ridgetops. It is the most extensive soil of the Ayar series mapped in the county.

Representative profile:

0 to 17 inches, brown to reddish-brown, very hard clay that is dark brown to dark reddish brown and firm when moist; structure is granular in the uppermost one-half inch and very coarse, prismatic and coarse, subangular blocky below; lime is both finely disseminated and segregated in small, hard concretions.

17 to 32 inches, reddish-brown, hard clay that is dark reddish brown and friable when moist; mildly alkaline and very strongly calcareous; lime is both finely disseminated and segregated as mycelium and in small, hard concretions.

32 to 54 inches +, hardened, white caliche interbedded with reddish-brown soil material and pale-yellow parent material; the upper 2 to 4 inches is extremely hard; moderately alkaline and extremely calcareous.

In color the surface layer ranges from brown or dark brown to reddish brown, and the subsoil from reddish brown to dark reddish brown. The texture is clay or silty clay. Depth to hardened caliche ranges from 24 to more than 50 inches but generally is 30 to 40 inches. The parent material is pale-yellow to yellowish-brown, softly consolidated sandstone and siltstone. This soil is calcareous throughout, and the amount of lime in it increases with increasing depth.

Permeability of this soil is slow. Runoff is slow to medium, and the erosion hazard is slight to moderate. Depth to which roots penetrate is moderately deep to deep. The available water holding capacity is 5 to 7 inches. Fertility is high.

Included with this soil are small areas of Nacimiento soils.

This Ayar soil is used mostly for dryfarmed grain and range. The forage is mainly wild oats, soft chess, and burclover. Because this soil is on narrow ridgetops where water is not available, it is not used for irrigated crops. Capability unit IIIe–5.

Ayar-Nacimiento clays, 10 to 30 percent slopes (AyD).—From 40 to 60 percent of this mapping unit is Ayar clay, 3 to 15 percent slopes, and the rest is Nacimiento clay, 15 to 30 percent slopes. The Ayar soil occupies the convex, rolling ridgetops, and the Nacimiento soil occupies the moderately steep, concave side slopes.

The soils in this mapping unit are used chiefly for range and dryfarmed barley. Dryfarmed safflower and sudangrass are grown on a few areas. Because of their location, strong slopes, and the shortage of irrigation water, irrigating these soils is not practical. Capability unit IVe–5.

Burris Series

Soils of the Burris series are deep, gently sloping to hilly, and generally are somewhat poorly drained. They are in areas below flat-topped buttes consisting of basalt at elevations of 300 to 800 feet. These soils formed in material from fine-textured, basic, igneous colluvium or alluvium. The vegetation is mostly annual grasses and forbs, but in a few widely scattered areas blue oaks grow. The average annual rainfall is 18 to 20 inches.

Burris soils characteristically have a surface layer of very dark gray cobbly clay. The subsoil is mottled, olive-gray, calcareous cobbly clay. In most areas a few boulders of basalt crop out. Seeps are common near the upper edges of the slopes.

These soils are used for range and produce forage of high value. They are too cobbly or bouldery for cultivated crops.

Burris bouldery clay, 10 to 30 percent slopes (BuD).—This soil is on long slopes surrounding the Orland Buttes. Large boulders cover 1 to 5 percent of the surface.

Representative profile:

0 to 19 inches, very dark gray, very hard, angular cobbly clay that is very dark gray and very firm when moist; granular structure in the upper one-half inch but angular blocky below; slightly acid but becomes neutral with increasing depth.

19 to 31 inches, dark-gray, very hard, angular cobbly clay that is dark olive and very firm when moist; massive; contains a few soft concretions of white lime; neutral to mildly alkaline and slightly calcareous.

31 to 46 inches +, mottled dark-gray, olive-gray, and white, very hard, very cobbly clay that is dark olive gray, olive gray, and light gray when moist; common, brown mottles; massive; contains lime segregated in small soft masses and hard concretions; mildly alkaline and strongly calcareous.

The surface layer ranges from dark gray to black, and the subsoil from dark grayish brown to olive brown or olive. Texture of these layers is cobbly clay or very cobbly clay. Depth to lime, as well as the amount of lime in the subsoil, varies within a short distance. In the areas around seeps, drainage is poor.

Permeability is slow. Runoff is medium, and the erosion hazard is moderate. The available water holding capacity is 5 to 6 inches.

Because of the many cobblestones and boulders, this soil is used for grazing by sheep and cattle. The range provides excellent early grazing of such desirable plants as burclover, wild oats, and soft chess, but in many areas medusahead, an undesirable plant, is invading. Capability unit VIs–5.

Burris cobbly clay, 3 to 15 percent slopes (ByC).—This soil is free of boulders. Runoff is slow to medium, and the erosion hazard is slight to moderate. The available water holding capacity is 5 to 7 inches. This soil is used as range for sheep and cattle. Capability unit VIs-5.

Burris clay, 1 to 8 percent slopes (BcB).—This soil is free of boulders and almost free of cobblestones. It is on low colluvial slopes or is on alluvial fans. Runoff is slow, and the erosion hazard is slight. The available moisture holding capacity is 8 to 9 inches. All areas of this soil are used for range. Capability unit IIIw–5.

Capay Series

The Capay series consists of deep, somewhat poorly drained, nearly level to gently sloping soils. These soils formed under annual grasses and forbs in alluvium washed from upland areas underlain by sedimentary rock. They are on alluvial fans and in depressional areas, mainly in the Sacramento Valley near Willows and Artois and in narrow valleys in foothills of the county. Elevations range from 100 to 1,000 feet, and the average annual rainfall is 16 to 20 inches.

The surface layer is dark grayish-brown to gray, neutral clay. It grades to light yellowish-brown or light olive-brown clay or clay loam that is moderately alkaline and calcareous. In most places these soils are free of gravel.

These soils are in the same general area as the Hillgate, Artois, Myers, and Clear Lake soils. The Myers soils are well drained, and the Clear Lake are poorly drained.

Capay soils are used for a wide variety of crops. Areas that are not irrigated are used for dryfarmed grain, safflower, and range. In irrigated areas ladino clover, milo, corn, pasture, and rice are the main uses.

Capay clay, 0 to 2 percent slopes (CaA).—This soil is mainly near Willows and Artois. The size of the areas vary; the range is from a few acres to 500 or 600 acres.

Representative profile:

0 to 21 inches, dark grayish-brown, very hard clay that is very dark grayish brown and very firm when moist; very coarse prismatic and medium to coarse blocky structure; slightly acid, but neutral in the lower part.

21 to 34 inches, similar to the horizon just above, except mildly alkaline and slightly calcareous; contains lime that is both finely disseminated and segregated in soft masses.

34 to 60 inches +, light olive-brown to light yellowish-brown, very hard clay that is olive brown and firm when moist and grades to heavy clay loam with increasing depth; massive when dry; a few strong-brown mottles in the lower part; moderately alkaline and strongly calcareous; contains lime that is finely disseminated or segregated in soft masses.

In color the surface layer ranges from dark grayish brown to very dark grayish brown to gray, and the subsoil from light olive brown or olive brown to light yellowish brown. The texture of the surface layer generally is clay, but in a few areas it is heavy clay loam. The subsoil is clay or clay loam. Strong-brown mottles generally are in the lower part of the subsoil, but in areas planted to rice, they occur in the surface layer. Depth to lime ranges from 15 to 36 inches but generally is at a depth of about 20 to 28 inches.

This soil is very slowly permeable. Runoff is very slow, and some areas remain flooded for a few days after a heavy rain. The erosion hazard is slight. The available water holding capacity is 8 to 10 inches. Root penetration is deep, and fertility is moderately high.

Included with this soil are small areas of Myers soils and of Clear Lake clay.

Much of this Capay soil is dryfarmed to small grain in rotation with pasture or is in range, but some areas are irrigated. Rice, irrigated pasture, milo, corn, and ladino clover are the main irrigated crops. In areas used for rice, the water table is at a depth of 2 to 4 feet during

the growing season, but it drops to a depth of more than 5 feet when the areas are drained so that the rice can be harvested. In a few areas east and south of Willows, small spots of alkali occur. Pheasant and waterfowl, mainly ducks and geese, are hunted in areas of this soil during the fall and winter. Capability unit IIIw–5.

Capay clay, 2 to 8 percent slopes (CaB).—This soil is along intermittent streams in narrow valleys in the foothills. A few areas are cut by gullies 4 to 7 feet deep.

Most of this soil is used for range, but some areas are in dryfarmed barley. It is unlikely that much of the acreage will be irrigated, because the areas are scattered and dependable sources of irrigation water are lacking. Capability unit IIIe–5.

Castro Series

In the Castro series are nearly level, poorly drained, fine-textured soils that have a hardpan. These soils formed in calcareous alluvium from sedimentary and metasedimentary rocks. They are in basins in the eastern part of the county at elevations of 80 to 150 feet. The prevailing water table is high. The vegetation is mainly hydrophytic plants, annual grasses, and forbs. The average annual rainfall is 16 to 18 inches.

The surface layer is dark-gray to black, calcareous clay about 15 to 20 inches thick. The subsoil is light-gray to nearly white, highly calcareous clay. It is abruptly underlain by cemented, white caliche, which is variable in thickness and grades to light olive-brown or olive-gray, stratified and gleyed loam and clay loam.

These soils are in the same general area as the poorly drained Sunnyvale and Willows soils. In many places the somewhat poorly drained Capay and Plaza soils are along the edges of areas of Castro soils.

Castro soils are used mainly for rice. Other irrigated crops are milo, corn, pasture plants, and some varieties of alfalfa. Dryfarmed crops are safflower and barley.

Castro clay (0 to 1 percent slopes) (Cb).—This soil, the most extensive Castro soil mapped in the county, is in basins in the district of Bayliss.

Representative profile:

0 to 17 inches, very dark gray, very hard clay that is black and very firm when moist; coarse, subangular blocky structure; mildly alkaline to moderately alkaline and slightly calcareous to strongly calcareous; contains finely disseminated lime that increases in amount with increasing depth.

17 to 32 inches, light-gray to nearly white, hard clay that is dark gray to gray and friable when moist; moderately alkaline and very strongly calcareous; contains both finely disseminated and segregated lime in a few, hard concretions.

32 to 42 inches, white, hardened caliche that becomes less strongly cemented with increasing depth; extremely hard and platy in upper one-fourth inch, massive below; moderately alkaline and extremely calcareous.

42 to 60 inches +, light olive-gray, hard, stratified loam and clay loam that is olive and friable when moist; many yellowish-brown mottles and olive-green gleyed spots; moderately alkaline and strongly calcareous; contains both finely disseminated and segregated lime in a few hard, large concretions.

In color, the surface layer is dark gray, very dark gray, or black and the subsoil is light gray to nearly white. The texture of the surface layer and subsoil is silty clay or clay. The surface layer generally is calcareous, but in some areas the upper 6 to 10 inches of it is leached of lime. The subsoil is strongly calcareous to extremely calcareous. Variations in this soil are mainly in the depth, thickness, and degree of cementation of the caliche hardpan. Depth to the hardpan ranges from 25 to 45 inches but generally is 30 to 36 inches. Thickness of the hardpan ranges from 2 to 12 inches, and the degree of cementation from slight to strong.

Included with this soil are some areas of Sunnyvale clay that make up 5 to 15 percent of the areas mapped. Also included are small areas of the Plaza and Willows soils.

In many areas of this soil, the caliche layer prevents downward and upward movement of water. The water table is high throughout the year but generally is highest during the ricegrowing season. Permeability and runoff are very slow. Root penetration is moderately deep, and fertility is high.

Much of the acreage of this soil is used for rice. Other irrigated crops are corn, milo, pasture plants, ladino clover, and some varieties of alfalfa. Dryfarmed crops are barley and safflower. Capability unit IIIw-5.

Castro clay, slightly saline-alkali (0 to 1 percent slopes) (Cba).—From 5 to 15 percent of the acreage of this soil is slightly to strongly affected by salts and alkali, but this soil is otherwise similar to Castro clay. It is used for the same crops, but growth of the crops is uneven, and yields are somewhat lower. Adding soil amendments, such as gypsum and ferric sulfate, temporarily reduces the effect of the salts and the alkali and increases yields. Capability unit IIIw–5.

Castro clay, moderately saline-alkali (0 to 1 percent slopes) (Cbb).—From 15 to 50 percent of the acreage of this soil is slightly to strongly affected by salts and alkali, but this soil is otherwise similar to Castro clay.

This soil is associated with other Castro soils and is used for the same crops. Yields are lower because of the excess salts and alkali. This soil is hard to reclaim because of the persistent high water table, but adding soil amendments, such as gypsum or ferric sulfate, temporarily reduces the effect of the salts and alkali. Capability unit IIIw–6.

Clear Lake Series

The Clear Lake series is made up of nearly level, poorly drained soils. These soils formed in alluvium, mainly from sedimentary and metasedimentary rocks, under a dense growth consisting of plants that tolerate wetness and of annual grasses and forbs. They are in basins or in swales adjacent to sluggish drainageways. Most areas are along nearly level drainageways in the foothills and in basins in the northeastern part of the county. Elevations range from 100 to 1,000 feet, and the average annual rainfall is 16 to 25 inches.

The surface layer is very dark gray or black clay that is slightly acid to neutral and about 20 to 30 inches thick. It grades to dark grayish-brown or grayish-brown clay that is mildly alkaline to moderately alkaline and cal-

careous. When dry, the structure in the surface layer is very coarse, prismatic, of the kind characteristic of adobe soils, and deep cracks form in this layer and extend into the subsoil.

Clear Lake soils are associated mainly with soils of the Capay, Hillgate, Myers, Tehama, and Zamora series.

Areas of Clear Lake soils that are not irrigated are used chiefly for range and dryfarmed barley. Irrigated areas are used for milo, corn, pasture, and rice.

Clear Lake clay (0 to 3 percent slopes) (Cc).—This is the only Clear Lake soil mapped in the county. It is in basins in the district of Capay and along sluggish drainageways in the foothills and in the Sacramento Valley.

Representative profile:

0 to 20 inches, very dark gray, very hard clay that is black and very firm when moist; very coarse prismatic and coarse subangular blocky structure; slightly acid, but neutral with increasing depth.

20 to 29 inches, similar to the horizon just above but mildly alkaline and slightly calcareous; contains lime that is segregated in soft masses and small, hard concretions.

29 to 52 inches +, dark grayish-brown to grayish-brown, hard clay that is very dark grayish brown and firm when moist; a few, brown or strong-brown mottles; a few pebbles; massive; mildly alkaline to moderately alkaline and strongly calcareous; contains lime that is finely disseminated and also segregated in soft masses, hard concretions, and around pebbles.

The surface layer is dark gray, very dark gray, or black, and the subsoil is grayish brown or dark grayish brown to light olive brown or olive. Mottles in the subsoil vary greatly. The profile generally is clay throughout, but in some places it is 5 to 15 percent gravel, by volume. When dry, very coarse prisms develop in the surface layer and wide cracks form that extend into the subsoil. The surface layer is slightly acid to neutral, and the subsoil is mildly alkaline to moderately alkaline and calcareous. Lime occurs in slight to moderate amounts in the subsoil, and in a few places it also is in the lower part of the surface soil. Depth to the water table ranges from 2 to 6 feet, depending on the season.

Clear Lake clay is poorly drained. In the district of Capay, one area is an intermittent lake and remains under water during much of the rainy season. Permeability and runoff are very slow. The erosion hazard is slight. In some areas incised drainageways are 5 to 10 feet deep. The available water holding capacity is 8 to 10 inches. Root penetration is deep.

Included with this soil are small areas of Capay soils. This Clear Lake soil is used chiefly for range and dryfarmed grain. If irrigation water is available, the areas are used for pasture, milo, corn, and rice. Capability unit IIIw–5.

Colluvial Land

Colluvial land consists of steep or very steep areas of unconsolidated colluvium. The colluvium is a heterogeneous mixture of soil material and rock fragments that moved downslope by gravity, rapidly as landslips, or slowly through flow of saturated material. The material is unstable and lacks distinct horizons. The areas were separated on the basis of the dominant type of rock material.

Colluvial land, sedimentary rocks (50 to 70 percent slopes) (CdsF) consists of a number of areas that are widely scattered throughout the Mendocino National Forest. It is made up of soil material mixed with small fragments of sedimentary or schistose rocks, moved downslope gradually by gravity. Drainage is good to excessive. Runoff is very rapid, and the erosion hazard is very high.

In most places the vegetation is shrubs, hardwoods, conifers, or mixtures of these in semidense to dense stands. A few areas at low elevations, however, have a cover of woods and grasses. The vegetation in a particular area, in general, is similar to that of the associated Los Gatos, Masterson, Josephine, Parrish, and Sheetiron soils.

Colluvial land, sedimentary rocks, is better suited to watershed, wildlife, and recreation than to other uses. Areas in shrubs have browse value in some places, depending on the species making up the stand. Areas in woods and grasses should be grazed lightly. All areas require protection from wildfire for control of erosion and to keep silt and debris from contaminating the streams. Capability unit VIIe–4.

Colluvial land, serpentine rocks (30 to 70 percent slopes) (CduF) is a heterogeneous mixture of Henneke soil material and serpentine rocks, moved downslope slowly as creep or mass flow of saturated material, or rapidly as landslips. These deposits of unconsolidated material are moderately deep to deep and rest unconformably on serpentine or other kinds of bedrock. Most of the acreage occupies a few areas near Red Mountain and Black Diamond Ridge. The vegetation is shrubs in open or partly open stands and a few widely scattered Digger pines.

Slopes in this land type are steep to very steep. Runoff is rapid to very rapid, and the erosion hazard is high to very high.

This land type has no value for farming. It is better suited to watershed, wildlife, and recreation than to other uses. The material that makes up this land type is unstable, and roadways should be routed around the areas. Capability unit VIIIs–9.

Colluvial land, volcanic rocks (50 to 70 percent slopes) (CdvF) is made up of material from Goulding, Hohmann, and Neuns soils, of very coarse fragments of metavolcanic rock, and of rock outcrops. It generally is more than 2 feet thick, is unstable, and is subject to downslope creep. It occupies many areas of various sizes near Black Butte and near St. John Mountain. The vegetation is shrubs, hardwoods, or conifers, and it generally is similar to that of the associated Goulding, Hohmann, and Neuns soils.

Drainage is excessive. Runoff is very rapid, and the erosion hazard is very high.

Colluvial land, volcanic rocks, is better suited to watershed, wildlife, and recreation than to other uses. All areas require protection from wildfire, for if the vegetation is destroyed, the soil material quickly erodes. Capability unit VIIs–7.

Columbia Series

The Columbia series consists of moderately well drained or somewhat poorly drained soils on recent alluvium from various kinds of rock. These soils are on flood plains of the Sacramento River, and most areas are nearly level to very gently sloping. Some areas are subject to occasional flooding and have an intermittent high water

table during winter and spring when the river is high. Old, abandoned channels and oxbow lakes are in a few areas. In many areas that directly border the river, streambank erosion (fig. 3) is a serious problem. The native vegetation on these soils was semidense or dense stands of various kinds of hardwoods that had a thick undergrowth of vines, shrubs, and weeds. Elevations range from 60 to 150 feet, and the average annual rainfall is 17 to 20 inches.

Columbia soils consist of pale-brown, stratified fine sandy loam or silt loam with strong-brown mottling in the subsoil. These soils generally are neutral in reaction. Lime occurs in the subsoil in a few places, but no excess salts and alkali are present.

A wide variety of row, field, truck, and orchard crops that are suited to the climate are grown on these soils. Occasional flooding and an intermittent high water table limit use somewhat. These hazards will be reduced when additional regulatory and storage facilities are constructed on the Sacramento River and its tributaries.

Columbia silt loam, 0 to 2 percent slopes (ChA).—This soil occupies areas along both sides of the Sacramento River from the Colusa County line to the Tehama County line. The areas vary greatly in shape and size. They range from less than 5 acres to more than several hundred acres in size. Except for a small acreage near Hamilton City, all areas of this soil are within the levee system that contains the Sacramento River.

Representative profile:

0 to 12 inches, pale-brown, slightly hard silt loam that is brown and friable when moist; massive; neutral.
12 to 58 inches +, pale-brown, slightly hard silt loam and very fine sandy loam; contains stratified, thin layers of loamy fine sand and sand that are brown and friable when moist; common strong-brown mottles, especially in the finer textured layers that overlie sandy layers; massive to single grain; neutral.

The color of the surface layer ranges from pale brown or brown to grayish brown, and that of the subsoil from pale brown to light yellowish brown. In some areas a slightly darker colored, old buried soil is present. Generally strong-brown mottling is more prominent in the finer textured strata than in the coarser textured strata. Contrasting textural layers of varying thickness are common in the subsoil. The surface layer is slightly acid to neutral, and the subsoil is neutral or mildly alkaline.

This soil is moderately well drained. Permeability is moderate, and runoff is slow. The available moisture holding capacity is 8 to 10 inches. Fertility is high. Areas that are not protected by levees are flooded periodically.

This soil is well suited to a wide variety of irrigated field, truck, forage, and orchard crops, as well as to many dryfarmed crops. Irrigated crops grown are alfalfa, corn,

Figure 3.—Streambank erosion in Columbia silt loam, 0 to 2 percent slopes, along the Sacramento River.

milo, beans, sugarbeets, tomatoes, prunes, almonds, and walnuts. Dryfarmed crops are barley, milo, safflower, and walnuts. A few uncleared areas are used for grazing. Where sand pockets were exposed when leveling was done, growth of plants is uneven.

The hazard of overflow on these soils was greatly reduced after construction of the Shasta Dam, but an intermittent high water table and occasional flooding still occur during winter and spring. These hazards will decrease when additional storage and regulatory facilities are constructed to further control the flow of the Sacramento River and its tributaries. Capability unit IIw–2.

Columbia silt loam, 2 to 8 percent slopes (ChB).—Most areas of this soil are in old channels that are partly filled with alluvium. This soil is slightly steeper than Columbia silt loam, 0 to 2 percent slopes, and is subject to flooding for a longer time. The intermittent water table is higher and remains so for longer periods during winter.

It is costly to remove the trees and thick undergrowth of vines and shrubs from areas of this soil, and few areas are cropped intensively. Areas that have a cover of natural vegetation are used for grazing. In cleared areas the crops grown are similar to those grown on Columbia silt loam, 0 to 2 percent slopes. Sprinkler irrigation can be used on this soil or leveling must be done. If leveling is done before irrigating, channel sand and gravel may be exposed in places. Capability unit IIw–2.

Columbia silt loam, moderately deep over clay loam, 0 to 1 percent slopes (Ck).—This soil overlies Wyo soils at a depth of 15 to 36 inches. It occupies an area southeast of Hamilton City, where it is protected from flooding by levees along the Sacramento River. This soil is moderately well drained. Permeability is moderate. A few spots contain excess salts and alkali.

This soil is used for the same crops as Columbia silt loam, 0 to 2 percent slopes. Capability unit I–1.

Columbia silt loam, moderately deep over claypan, 0 to 1 percent slopes (Cl).—This soil overlies Hillgate soils at a depth of 20 to 36 inches. It occupies a few areas in the district of Capay, southeast of the pumping plant for the Glenn-Colusa Irrigation District. Drainage is moderately good. Runoff and permeability are slow. The available moisture holding capacity is 6 to 8 inches.

Irrigated, shallow-rooted orchard and field crops and pasture plants are better suited to this soil than other crops. Capability unit IIIs–3.

Columbia silt loam, moderately deep over gravel, 0 to 2 percent slopes (Cm).—This soil overlies stratified channel sand and gravel at a depth of 20 to 36 inches. It occupies a few small areas southeast of Hamilton City near the confluence of Stony Creek and the Sacramento River. Drainage is moderately good. Permeability is moderate throughout the silt loam, but it is very rapid through the underlying sand and gravel. The available moisture holding capacity is 4 to 6 inches.

Crops grown on this soil are the same as those grown on Columbia silt loam, 0 to 2 percent slopes. When leveling and grading are done, deep cuts must be avoided to keep from exposing the underlying sand and gravel. Capability unit IIIw–0.

Columbia silt loam, shallow over clay, 0 to 1 percent slopes (Cn).—This soil is in the eastern part of the county adjacent to Butte Creek. It formed in deposits that are 10 to 24 inches thick over Stockton clay. The deposits are similar to Columbia silt loam, 0 to 2 percent slopes, and the underlying clay is like the deep Stockton clay. Drainage is somewhat poor. Permeability is very slow. The available water holding capacity is 8 to 10 inches.

An intermittent high water table limits use of this soil chiefly to rice, irrigated pasture, and shallow-rooted field crops. The levee system along Butte Creek protects this soil from annual overflow, but flooding occurs in places when rainfall is above normal. Capability unit IIIw–5.

Columbia silt loam, shallow over clay, channeled, 0 to 3 percent slopes (Co).—This soil formed in recent, stratified material deposited over Stockton clay by annual overflow. It occupies a few small areas parallel to Butte Creek along the eastern boundary of the county. Many channels dissect the areas. The vegetation consists of thick growths of weeds and grasses and dense stands of valley oaks, cottonwoods, and willows. Drainage is somewhat poor.

The hazard of annual overflow restricts use of this soil to grazing. Fresh deposits of soil material and other debris are deposited annually by overflow. Extending the Butte Creek levee system would protect the areas from overflow and permit more intensive use of this soil. Capability unit VIw–1.

Columbia silt loam, water table, 1 to 8 percent slopes (CpB).—This soil is in old channels of the Sacramento River that have been partly filled with soil material. Most areas are narrow and crescent shaped, and some areas contain small oxbow lakes. This soil has prominent mottling and gleying in the subsoil, a permanent high water table, and a greater overflow hazard, but it is otherwise similar to Columbia silt loam, 0 to 2 percent slopes. The water table is at a depth of 2 to 3 feet all year, and drainage is poor. Dense stands of cottonwoods, willows, sycamores, black walnuts, and valley oaks that have a thick undergrowth of vines, berry plants and other weedy plants make up the vegetation.

Few areas of this soil are cultivated. The water table is at the same level as the Sacramento River, and little can be done to improve the drainage. Periodic flooding is a hazard, as all areas are within the Sacramento River levee system. Shallow-rooted annual crops or moderately deep rooted perennial crops that tolerate wetness are better suited to these soils than other crops. If irrigated, the areas must be leveled or sprinkler irrigated. Uncleared areas are used for grazing, but the thick undergrowth prevents efficient grazing. Capability unit IIIw–3.

Columbia fine sandy loam, 0 to 2 percent slopes (CeA).—This soil is fine sandy loam throughout. Drainage is moderately good. Permeability is moderately rapid. The available water holding capacity is 7 to 8 inches.

Crops grown on this soil are the same as those grown on Columbia silt loam, 0 to 2 percent slopes. Some areas that directly border the Sacramento River are subject to streambank erosion. Capability unit IIw–2.

Columbia fine sandy loam, 2 to 8 percent slopes (CeB).—This soil occupies a medium-sized area north of the site of the old McIntosh Landing. A few, old, abandoned channels cut through the area. The vegetation is a dense stand of valley oaks, sycamores, cottonwoods, black walnuts, and willows and a thick undergrowth of vines and shrubs. Drainage is moderately good. Runoff

is slow to medium, and the erosion hazard is slight to moderate.

This soil is used for grazing. An intermittent high water table and overflow from the Sacramento River limit use. If this soil were cleared, it could be used for dryfarmed grain, milo, and safflower. If this soil is irrigated, it is more practical to level the areas for flood or furrow irrigation than to use overhead sprinklers. Care is needed when leveling is done to keep from exposing small pockets of sand or gravel. If sprinkler irrigation is used without leveling, erosion is likely to be a problem on the steeper slopes. Capability unit IIw–2.

Columbia fine sandy loam, moderately deep over sand and gravel, 0 to 2 percent slopes (Cf).—This soil overlies sand or gravel at a depth of 20 to 36 inches, and it is therefore droughty. Most areas border the Sacramento River or areas of Riverwash. They are therefore subject to flooding and an intermittent high water table during winter and spring.

Permeability is moderately rapid in the fine sandy loam part of this soil, but it is rapid in the sand and gravel part. Drainage is moderately good. The available water holding capacity is 4 to 6 inches. The vegetation is mainly annual grasses and weeds and a few, scattered cottonwood, willow, and sycamore trees.

Most areas of this soil are used for range or dryfarmed grain. An intermittent high water table and periodic flooding limit the choice of crops. Many crops can be grown successfully, however, under irrigation. If leveling is done, cuts should be shallow to keep from exposing the underlying sand and gravel. Capability unit IIIw–0.

Columbia loamy fine sand, coarse variant, 0 to 2 percent slopes (CgA).—This soil occupies small areas within larger areas of finer textured Columbia soils. Permeability is rapid. The available water holding capacity is 4 to 5 inches, and fertility is moderate. Drainage is moderately good. An intermittent high water table and overflow from the Sacramento River are problems.

Because of their small size and location, areas of this soil are difficult to manage. They are used for the same field and orchard crops as those that grow on the adjacent, finer textured Columbia soils. Capability unit IIIw–3.

Columbia loamy fine sand, coarse variant, 2 to 8 percent slopes (CgB).—This soil occupies two areas near the Sacramento River southeast of Hamilton City. Slopes are steeper, but this soil otherwise is similar to Columbia loamy fine sand, coarse variant, 0 to 2 percent slopes. Runoff is slow, and the erosion hazard is slight to moderate. Drainage is moderately good.

This soil is used for dryfarmed grain and range. If it is irrigated, many field, truck, and orchard crops can be grown successfully. The slopes, coarse texture, and droughtiness make this soil better suited to sprinkler irrigation than to other kinds of irrigation. Capability unit IIIw–0.

Columbia soils, channeled, 0 to 10 percent slopes (CrB).—This mapping unit borders areas of Riverwash or the Sacramento River. It is on material deposited recently by overflow from the river. The areas are cut by many channels, which carry water during periods of heavy runoff. Most areas are covered by water for short periods in winter and spring. The soil material consists of many kinds of Columbia soils. The surface soil ranges from loose sand to silt loam within a short distance. The soil material is stratified, and depth to underlying sand and gravel varies greatly. The water-holding capacity ranges from very low to high, depending on the soil texture and amount of stratification. Dense stands of cottonwood, willow, sycamore, black walnut, and black oak trees, with a thick understory of vines and shrubs, make up the vegetation.

None of this mapping unit is used for intensive farming because of the flooding hazard, many channels, variability in texture and stratification of the soil material, and the high cost of clearing and leveling the areas. The areas are all used for grazing. Capability unit VIw–1.

Contra Costa Series

The Contra Costa soils are moderately deep, gently sloping to steep, and well drained. These soils formed in material from hard, unaltered sandstone and shale of the Cretaceous period. They occupy large areas in the western foothills of the county at elevations of 500 to 2,000 feet. The vegetation is chaparral or grass and oak. The average annual rainfall is 18 to 25 inches.

These soils generally have a surface layer of brown, heavy clay loam or light clay. The subsoil is brown to reddish-brown clay. They typically are nongravelly and free of rock outcrops and range from slightly acid to neutral throughout.

Contra Costa soils generally are associated with soils of the Millsholm and Sehorn series. Most areas of these soils are used as range for cattle and sheep. The rolling to hilly areas are dryfarmed to barley in a few places.

Contra Costa clay loam, 30 to 65 percent slopes (CtE).—This soil generally is on north-facing slopes under annual grasses, blue oaks, and a few Digger pines. In a few places semidense to dense patches of scrub oak and other low shrubs grow.

Representative profile:

0 to 5 inches, brown, hard heavy clay loam that is dark brown and friable when moist; a few, small shale fragments; granular structure; very slightly acid to neutral.
5 to 21 inches, brown to reddish-brown, very hard clay that is dark reddish brown and very firm when moist; coarse, angular blocky structure; very slightly acid to neutral.
21 to 34 inches, brown, very hard shaly clay that is dark reddish brown and firm when moist; coarse, subangular blocky structure; slightly acid to neutral.
34 inches +, fractured, light yellowish-brown and light olive-brown, noncalcareous, fine-grained sandstone and shale.

In color the surface layer ranges from pale brown or brown to light reddish brown. The subsoil is redder than the surface layer and ranges from strong brown to reddish brown. Texture of the surface layer ranges from heavy clay loam to light clay. The subsoil is clay or shaly clay. Rocks crop out in a few places. The profile generally is slightly acid to neutral throughout. Depth to parent rock ranges from 20 to 40 inches.

Permeability of this soil is slow. Runoff is rapid, and the erosion hazard is severe. The available water holding capacity is 5 to 6 inches. Roots penetrate the full depth of the profile and in places are along cracks in the parent rock.

Contra Costa clay loam, 30 to 65 percent slopes, is all used as range for sheep and cattle. Capability unit VIe–5.

Contra Costa clay loam, shallow, 30 to 65 percent slopes, eroded (CuE2).—In this soil depth to parent rock is 12 to 24 inches. Runoff is rapid to very rapid, and the erosion hazard is moderate. The available moisture holding capacity is 3 to 5 inches.

Semidense to dense stands of chamise and other low shrubs grow on this soil, which is used for range. Capability unit VIe–5.

Contra Costa clay, shallow, 3 to 8 percent slopes (CsB).—In this soil the surface layer is a light clay. Depth to parent rock is 15 to 24 inches. Permeability is slow, runoff is slow to medium, and the erosion hazard is slight. The available moisture holding capacity is 3 to 4 inches.

This soil is used for dryfarmed grain in rotation with pasture. Capability unit IVe–5.

Contra Costa-Millsholm clay loams, 30 to 65 percent slopes (CvE).—This mapping unit consists of Contra Costa clay loam, 30 to 65 percent slopes, and of Millsholm clay loam, 30 to 50 percent slopes. Either soil may make up 40 to 60 percent of any one area. The Contra Costa soil is moderately deep and occupies north slopes in more humid areas than those occupied by Millsholm soils, which are shallower and are on ridgetops and south slopes. Some of the areas are along Stony Creek (fig. 4).

These soils are all used for range. Capability unit VIe–5.

Corning Series

Soils of the Corning series are nearly level to gently sloping and are well drained. These soils formed on old, gravelly and cobbly alluvium from sedimentary and metamorphic rocks of the Coast Range Mountains. They are on high terraces that have been partly dissected by streams and have a hummocky microrelief. The native vegetation was annual grasses and forbs. Elevations range from 250 to 1,200 feet, and the average annual rainfall is 17 to 25 inches.

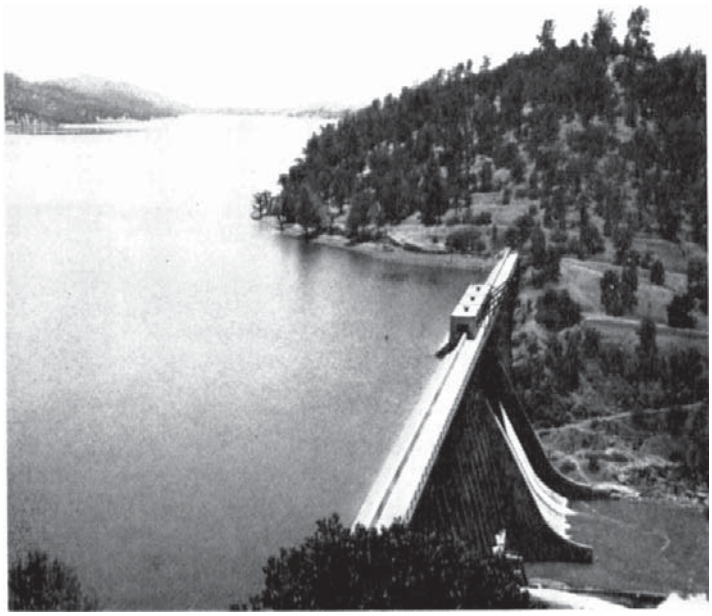

Figure 4.—Stony Gorge Reservoir on Stony Creek, a storage facility of the Orland Water Users Association. In the right background are Contra Costa-Millsholm clay loams, 30 to 65 percent slopes.

The surface layer is yellowish-red or reddish-brown gravelly loam, and the subsoil is reddish-brown or red, slightly gravelly, dense clay. Poorly sorted, very gravelly or cobbly sandy loam or sandy clay loam makes up the substratum. The surface layer is medium acid to strongly acid, and the subsoil and substratum are medium acid to neutral.

These soils are used mainly for pasture and range, but some areas are in dryfarmed barley.

Corning gravelly loam, 2 to 8 percent slopes (CwB).—This soil is on partly dissected high terraces west and southwest of Orland. Low hummocks are evident in most areas.

Representative profile:

0 to 14 inches, yellowish-red, hard gravelly loam that is reddish brown and friable when moist; the gravel is mainly quartzite and multicolored chert; a thin layer of gravel covers the surface; massive; medium acid.

14 to 27 inches, reddish-brown, extremely hard clay that is dark red and very firm when moist; contains a few pebbles; prismatic structure in the uppermost 3 to 4 inches but angular blocky structure below; medium acid to slightly acid.

27 to 40 inches, mottled yellowish-red and light yellowish-brown, very hard, slightly gravelly clay loam that is yellowish red and yellowish brown and firm when moist; massive; medium acid.

40 to 60 inches +, mottled light yellowish-brown, yellowish-red, and red, hard, stratified gravelly and very gravelly sandy clay loam and sandy loam; a few cobblestones, but these increase in number with increasing depth; massive; medium acid.

The surface layer contains a few cobblestones in places. It ranges in texture from gravelly sandy loam to loam. The subsoil contains less gravel and cobblestones than the surface layer and the substratum. It ranges in texture from clay that is nearly free of coarse fragments to gravelly clay. Depth to the claypan ranges from 8 to 22 inches. In some places a thin, bleached horizon caps the prisms in the upper part of the claypan. The substratum varies in color, texture, and amount of gravel and cobblestones.

Runoff is slow to medium on this soil, and the erosion hazard is slight to moderate. The surface layer is moderately permeable, and the subsoil is very slowly permeable. Root penetration is shallow. The available water holding capacity is 4 to 5 inches.

This soil is used mainly for early pasture in rotation with barley. The chief plants in the pasture are filaree and other annual forbs and grasses. Because the water-holding capacity of this soil is low and the chance of rain in spring is uncertain, fertilizing dryfarmed grain generally is not done. Pasture can be grown on this soil under irrigation if ample water for irrigation is available at low cost. Capability unit IVe–3.

Corning gravelly loam, 0 to 2 percent clopes (CwA).—This soil is on remnants of high terraces, southwest of Orland, and in the valley of Stony Creek, south of Elk Creek. Most areas have a pronounced hummocky microrelief. Runoff is very slow, and the erosion hazard is slight.

This soil is used for pasture or range and for dryfarmed barley. Irrigated pasture plants and other shallow-rooted forage crops can be grown successfully if water is available for irrigation. Capability unit IVs–3.

Corning-Gullied land complex, 2 to 10 percent slopes (CwxB).—This complex consists of Corning gravelly loam that is cut by gullies and is more sloping but otherwise is similar to Corning gravelly loam, 2 to 8 percent slopes. The gullies are 4 to 6 feet deep and are at intervals of 500 to 1,000 feet.

This unit is used for pasture or range and for dryfarmed barley. It is difficult to cultivate crops and to harvest them because of the gullies. Capability unit IVe-3.

Corning-Newville gravelly loams, 3 to 15 percent slopes (CxC).—This mapping unit is made up of Corning gravelly loam on 3 to 8 percent slopes, and of Newville gravelly loam, 3 to 15 percent slopes. From 40 to 60 percent of each area is Corning soil, and the rest is Newville soil. The Corning soil is on the rounded, gently sloping ridgetops, and the Newville soil is on the steeper side slopes. Runoff is slow to medium, and the erosion hazard is slight to moderate.

All of this mapping unit is used for pasture in rotation with dryfarmed barley. Capability unit IVe–3.

Corning-Newville-Gullied land complex, 3 to 15 percent slopes (CyC).—This complex consists of Corning and Newville gravelly loams that are cut by gullies. The gullies are 4 to 6 feet deep and are at intervals of 500 to 1,000 feet.

This mapping unit is used for pasture or range and for dryfarmed barley. The soils in this complex are more difficult to farm than other Corning and Newville soils because of the gullies. Capability unit IVe–3.

Corning-Redding gravelly loams, 1 to 5 percent slopes (CzB).—This mapping unit is made up of nearly equal parts of Corning gravelly loam and Redding gravelly loam. These soils are very gently sloping and have a pronounced hummocky microrelief. Permeability is very slow. Runoff is slow, and the erosion hazard is slight.

This mapping unit is used as early pasture and range for sheep and cattle, or it is used for dryfarmed barley. The kind of plants on the soils are the same as those that grow on other Corning and Redding soils. Irrigated pasture can be grown if water is available for irrigation at low cost. Capability unit IVe–3.

Cortina Series

The Cortina series consists of excessively drained soils on recent gravelly alluvium from schistose, sedimentary, and metavolcanic rocks. These soils are in abandoned stream channels or are on recent flood plains that are subject to occasional flooding. The native vegetation was annual grasses and forbs and open stands of hardwoods and low shrubs. Elevations range from 127 to 1,200 feet, and average annual rainfall is 16 to 25 inches.

These soils are characteristically gravelly or very gravelly and coarse textured or moderately coarse textured. They are shallow to moderately deep over channel sand and gravel. These soils typically have a light brownish-gray or grayish-brown surface layer that is slightly acid. The subsoil is similar in color and is slightly acid to neutral. The gravel is mainly quartzite and multicolored chert.

Cortina soils are used chiefly for pasture or range. They are not well suited to dryfarmed crops, because their water-holding capacity is low. A few irrigated forage, row, and tree crops are grown on these soils, but irrigation must be done frequently to maintain the moisture needed for these crops.

Cortina very gravelly sandy loam, moderately deep (Czf).—This soil is on recent flood plains along Stony Creek, and the areas are quite variable in size and shape. The largest acreages are in the districts of Orland and Plaza.

Representative profile:

0 to 32 inches, light brownish-gray, slightly hard, very gravelly sandy loam that is dark grayish brown and friable when moist; massive; slightly acid, but very slightly acid to neutral with increasing depth.
32 to 60 inches +, multicolored river sand and gravel; loose; single grain; neutral.

This soil ranges from light brownish gray to grayish brown in color, and from gravelly or very gravelly loamy sand to sandy loam in texture. Depth to the underlying channel sand and gravel ranges from 20 to 40 inches. The surface layer ranges from slightly acid to very slightly acid, and the subsoil from slightly acid to mildly alkaline.

Permeability of this soil is very rapid. The available water holding capacity is 2 to 4 inches. Fertility is low.

In many places this soil is near narrow stringers of Riverwash and small areas of nongravelly Orland soils.

This Cortina soil is used mainly for pasture or range and for dryfarmed barley. Irrigated crops include alfalfa, ladino clover, pasture plants, figs, and almonds. This soil provides good bedding grounds and feedlots for livestock during the wet winter and spring months. Sand and gravel are mined from a few pits in this soil. Capability unit IVs–4.

Cortina very gravelly sandy loam (0 to 3 percent slopes) (Czr).—In this soil depth to sand and gravel is more than 36 inches. Permeability is very rapid, and the available moisture holding capacity is 3 to 5 inches.

Most areas of this soil occupy narrow areas that are small or medium in size. One area, however, ranges from ¼ to ¾ of a mile wide and extends southward from west of Orland to east of Willows.

This soil is used chiefly for dryfarmed barley and range. A few areas are in abandoned fig orchards. Sprinkler irrigation has been used in growing alfalfa with only partial success. Sand and gravel are mined from several large pits in this soil. Capability unit IVs–4.

Cortina very gravelly sandy loam, shallow (0 to 3 percent slopes) (Czs).—In this soil depth to sand and gravel generally is 10 to 24 inches. Permeability is very rapid, and the available moisture holding capacity is 1 to 3 inches.

This soil is used mainly for range. A few areas are used as bedding grounds and feedlots for turkey and livestock. Sand and gravel are mined from several, large open pits. Capability unit IVs–4.

Cortina gravelly fine sandy loam (0 to 3 percent slopes) (Czh).—This soil is slightly finer textured and somewhat less gravelly than Cortina very gravelly sandy

loam, moderately deep. Depth to channel sand and gravel ranges from 24 to 42 inches. Permeability is rapid, the available water holding capacity is 3 to 5 inches, and fertility is low.

This soil is made up of many areas that generally are less than 10 acres in size. It is used for the same crops as Cortina very gravelly sandy loam, moderately deep. Capability unit IIIs–4.

Cortina gravelly fine sandy loam, shallow (0 to 3 percent slopes) (Czk).—Depth to sand and gravel in this soil is 10 to 24 inches. Permeability is very rapid, and the available moisture holding capacity is 1½ to 3 inches.

This soil is used chiefly for range. A few areas are used as bedding grounds or feedlots for livestock. Capability unit IVs–4.

Cortina gravelly loam, water table (0 to 2 percent slopes) (Czg).—This soil has a slightly finer textured surface layer and subsoil than Cortina very gravelly sandy loam, moderately deep. The surface layer also is paler brown. This soil occupies a few small areas adjacent to Walker Creek, and when the creek is high, the water table in this soil is high. Permeability is very rapid. The available moisture holding capacity is 2 to 3 inches.

Because individual areas of this soil are small, it is difficult to manage this soil separately. The areas therefore generally are used for the same dryfarmed crops as are grown on the adjacent Arbuckle and Tehama soils. A few areas are used for irrigated pasture. Capability unit IVs–4.

Dubakella Series

Soils of the Dubakella series are shallow or moderately deep, hilly to steep, and well drained. These soils formed in material from serpentine rock. They occupy a few acres in the southwest corner of the county at elevations of 4,500 to 5,500 feet. The native vegetation was open stands of conifers. Average annual rainfall is 50 to 60 inches.

These soils typically have a surface layer of reddish-brown stony loam or light clay loam. The subsoil, a yellowish-brown stony clay loam, overlies fractured and partly weathered serpentine bedrock. The amount of gravel and stones in the profile increases with increasing depth. The soils are neutral throughout.

Dubakella soils are associated with the Neuns soils, which formed under trees in material from metavolcanic rock, but those soils are brown and are deeper than Dubakella soils. They are similar to the Henneke soils, which are also on serpentine but formed under brush and have a clayey subsoil.

These soils are better suited to timber and to watershed and recreational use than to other uses. The ratio of calcium to magnesium is low, and these soils are therefore less productive than the associated Neuns soils.

Dubakella stony loam, 30 to 50 percent slopes (DuE).—This is the only Dubakella soil mapped in this county. It consists of two small areas west of St. John Mountain. Stones occupy from 2 to 10 percent of the surface. Open stands of Jeffrey pine and incense-cedar make up the vegetation.

Representative profile:

2 inches to 0, fresh and partly decomposed litter from conifers.
0 to 3 inches, reddish-brown, soft stony loam that is dark reddish brown and very friable when moist; fine, granular structure.
3 to 10 inches, reddish-brown, slightly hard gravelly light clay loam that is dark reddish brown and friable when moist; subangular blocky structure; neutral.
10 to 18 inches, yellowish-brown, slightly hard gravelly clay loam that is dark yellowish brown and friable when moist; subangular blocky structure; neutral.
18 inches +, fractured, bluish-green, hard, serpentine rocks; in the upper part the cracks between the rocks are filled with soil from the horizon just above.

In places the surface layer is brown and the subsoil ranges from yellowish brown or brown to strong brown. Depth to bedrock generally ranges from 15 to 30 inches. The amount and size of the gravel and stones increase with increasing depth. The shallower soils are more stony than the deeper ones. Reaction is about the same throughout.

Runoff is medium to rapid on this soil, and the erosion hazard is severe. Permeability is moderately rapid in the surface layer and moderate in the subsoil. The available water holding capacity is 2 to 4 inches. Fertility is low.

This soil is better suited to timber, watershed, and recreation than to other uses. Capability unit VIs–7.

East Park Series

The East Park series consists of very gently sloping to strongly sloping, well-drained gravelly or cobbly clays. These soils formed in alluvium predominantly from ultrabasic rock. The rock is mainly serpentine but in places includes pillow basalt or greenstone. These soils are on small alluvial fans along the eastern edge of areas on serpentine, where the serpentine is the contact between rock of the Knoxville and Franciscan formations. The vegetation is mainly grasses and forbs but includes some scattered blue oaks. Elevations range from 1,000 to 1,500 feet, and the average annual rainfall is 20 to 30 inches.

These soils are reddish brown to dark reddish brown and are fine textured throughout. The surface layer is gravelly, and the subsoil is very gravelly. Reaction of the surface layer is neutral, and that of the subsoil is neutral to mildly alkaline. Cobblestones and larger stones are common.

All areas of East Park soils are used as annual range for sheep and cattle.

East Park gravelly clay, 2 to 10 percent slopes (EcB).—This soil is on small alluvial fans along the base of areas on serpentine. Some of the areas are west of Chrome and others are west of Gravelly Ridge and near the Colusa County line.

Representative profile:

0 to 20 inches, reddish-brown to dark reddish-brown, hard gravelly clay that is dark reddish brown and friable to firm when moist; a few cobblestones and larger stones are on the surface; very coarse, prismatic structure; neutral.
20 to 60 inches +, reddish-brown, hard gravelly sandy clay that is very gravelly and cobbly with increasing depth and is dark reddish brown and firm when moist; below a depth of 30 inches the color is mixed reddish brown and brown; massive; mildly alkaline.

The surface layer is reddish brown or dark reddish brown, and the subsoil is brown to reddish brown. Texture is dominantly clay or heavy clay loam throughout.

The amount of gravel and cobblestones in the profile varies, and these coarse fragments generally increase in size and amount with increasing depth. Cobblestones and larger stones are common, and they vary in amount within a short distance. The surface layer is slightly acid to neutral and is more alkaline with increasing depth. Depth to unrelated formations in the substratum generally is deep, but it is shallow in places at the lower edges of the fans. In Green Valley south of Briscoe Creek, the soil is olive brown in color.

Permeability of this soil is slow. Runoff is slow to medium, and the erosion hazard is slight. Root penetration is deep. The available water holding capacity is 4 to 6 inches. Because of the low ratio of calcium to magnesium, fertility is low.

All of this soil is used for range. The forage is mainly low-growing annual forbs that contain little nutrients, but a few annual and perennial grasses grow on the areas. This soil is not well suited to cultivated crops, because it is gravelly or cobbly and is low in fertility. Capability unit IVe–9.

East Park clay, black variant, 10 to 30 percent slopes (EaD).—This variant from East Park clay is in a small, poorly drained seep at Black Diamond Glades. It is black clay throughout and is moderately alkaline and calcareous below a depth of 28 inches. Depth to serpentine rock is more than 45 inches. Runoff is medium, and the erosion hazard is moderate.

A dense cover of sedges, grasses, and forbs that tolerate wetness grow on this soil. These plants provide forage for wildlife and livestock. Capability unit IVe–9.

Eroded Land

Eroded land is made up of severely eroded areas of Landlow or Lodo soils. The areas consist of exposed hardpan or shale.

Eroded land, alluvial material (0 to 3 percent slopes) (Er) consists of severely eroded areas of Landlow soils. Almost all soil material above the hardpan has been removed from these soils by stream erosion, and nearly barren areas of hardpan are exposed.

This land type is made up of several small areas along Campbell Slough that are irregular in shape. The areas are on the first bench above the stream channel, where they are subject to annual flooding and severe erosion. The vegetation is mainly annual grasses and forbs.

This land type is not suited to tillage. It has little value for farming other than limited use for grazing. Capability unit VIIIw–4.

Eroded land, shale material (30 to 70 percent slopes) (EsE) consists of severely eroded areas of Lodo soils and barren exposures of Knoxville shale. Slopes are steep to very steep. Runoff is very rapid, and the erosion hazard is severe.

Most areas of this mapping unit are in the foothills between Newville and the Colusa County line, near the Lodo, Millsap, and Millsholm soils. In many places the areas are on steep, west-facing slopes of hogback ridges. The vegetation is open stands of shrubs and junipers that have an understory consisting of a few annual grasses and forbs around the base of the woody plants. In a few areas blue oaks grow in open stands.

This land type has no value for farming other than the small amount of forage produced. If the areas are grazed, grazing must be controlled carefully to prevent further erosion. In places this land type has limited use as wildlife, watershed, and recreation areas. Capability unit VIIIs–8.

Goulding Series

Soils of the Goulding series are shallow, steep to very steep, and somewhat excessively drained. These soils formed in material from greenstone and from related basic metavolcanic rock. They are on rocky mountainous slopes at elevations of 2,000 to 4,000 feet. The vegetation is mainly brush or brush and grass. The average annual precipitation ranges from 25 to 40 inches.

Goulding soils are brown, medium textured, and slightly acid or very slightly acid throughout. They are granular and are very friable. Gravel and cobblestones make up from 30 to 60 percent of the soil mass, and in places rock outcrops occupy from 5 to 50 percent of the surface. Depth to weathered bedrock ranges from 10 to 30 inches, but it generally is less than 20 inches.

These soils occur in the same general area as the Maymen and Los Gatos soils, which formed under brush in material from sedimentary and metasedimentary rocks. They generally occupy slopes below areas of the Neuns and Hohmann soils, which are also on greenstone and related metavolcanic basic rock but formed under trees.

Goulding soils are better suited to use as watershed areas and as habitats for wildlife than to other uses. Burned areas in some places produce enough grass for limited grazing.

Goulding rocky loam, 50 to 65 percent slopes (GoF).—This shallow soil is on rocky mountainous slopes. In most areas rock outcrops occupy from 5 to 25 percent of the surface.

Representative profile:

0 to 16 inches, brown, soft very gravelly loam that is dark brown and very friable when moist; medium to coarse, granular structure; very slightly acid; contains gravel and cobblestones that increase in size and amount with increasing depth; a thin litter of shrub leaves and twigs is on the surface.

16 inches +, hard, fractured greenstone and related metavolcanic basic rocks; some soil material and roots are in cracks between the rocks.

The color generally ranges from brown or dark brown to yellowish brown, but in some places it is pinkish gray or reddish gray. The texture is gravelly to very gravelly loam or light clay loam. Angular cobblestones are common and increase in amount and size with increasing depth. Depth to bedrock generally is 10 to 20 inches, but in places on less steep slopes it is as much as 30 inches. Rock outcrops generally occupy less than 25 percent of the surface, but in some places they cover as much as 50 percent of it. Reaction is slightly acid or very slightly acid throughout.

Permeability of this soil is moderately rapid. Drainage is somewhat excessive, and the available water holding capacity is 2 to 3 inches. Runoff is very rapid, and the erosion hazard is very severe. Fertility is low. Root penetration is shallow, but in places the larger roots penetrate cracks in the bedrock.

This soil is on the lower south- and east-facing slopes of St. John Mountain. The vegetation is mainly brush,

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but areas recently burned over support thin stands of annual grasses. This soil is good for watershed areas and for wildlife habitats. In places burned areas provide browse for deer and limited grazing for livestock. Capability unit VIIIs–7.

Goulding rocky loam, 30 to 50 percent slopes (GoE).—Areas of this soil are on the lower slopes of St. John Mountain or are near Fiddlers Green. Runoff is rapid, and the erosion hazard is severe.

Included with this soil are some pinkish-gray soils, formerly known as Fouts soils, and small areas of Rock land.

This Goulding soil is good for wildlife habitats and watershed protection. Burned areas provide some browse for deer and limited grazing for livestock, and because they are open, are easily accessible to sportsmen. Capability unit VIIs–7.

Gravel Pits

Gravel pits (Gp) consists of open pits from which sand and gravel have been removed for railroad ballast, road construction, industrial uses, and other purposes. Material is still being mined from some of the pits, but many of the pits have been abandoned or have not been worked for a number of years.

Most Gravel pits are in areas of Riverwash or in the Cortina and Arbuckle soils, but a few pits are in the Newville and Corning soils. Pits in the rice-producing area of the county are flooded during the irrigation season, and willows and cottonwoods have become established around the edges of these pits.

This miscellaneous land type has no value for farming. The areas are variable and onsite inspection is therefore needed before the areas can be classified.

Gravelly Alluvial Land

Gravelly alluvial land (0 to 8 percent slopes) (Gr) consists of gravelly alluvium stratified with coarse- and medium-textured soil material. The material making up this land type varies greatly from place to place and lacks distinct horizons. This land type is on low benches and flats along Stony Creek and its major tributaries. It is subject to overflow, and in many places it is cut by stream channels into small areas that are irregular in shape. The vegetation is open to moderately dense stands of trees, such as oak, cottonwood, willow, and tamarisk, which have an understory of annual grasses and forbs.

The amount of overflow and deposition varies. Some areas are likely to be flooded several times a year, but other areas are flooded only once in several years. The floodwater deposits material on some areas, but it erodes other areas or cuts channels through them.

Included with this land type are small areas of Riverwash and of Cortina and Orland soils.

In some places Gravelly alluvial land produces forage of good quality and therefore provides desirable range. Because of the hazards of flooding and erosion, the areas are not suitable for cultivated crops. Capability unit VIw–1.

Henneke Series

In the Henneke series are shallow, well-drained, stony soils. These soils formed in material from serpentine rock. They are on rolling to hilly ridgetops and steep to very steep canyon slopes. The areas are in the western part of the county along the eastern edge of the Mendocino National Forest, between the central foothills and the mountains. The vegetation is mostly shrubs of various kinds but includes some Digger pines. Elevations range from 1,000 to 4,000 feet. The average annual rainfall is 20 to 35 inches.

The surface layer is thin, reddish-brown gravelly clay loam, and the subsoil is dark reddish-brown gravelly clay. The soil is neutral throughout. Rock outcrops are common, especially on the steeper slopes.

Henneke soils generally are associated with soils of the Lodo, Maymen, and Stonyford series, all of which are shallow.

The Henneke soils are not suitable for crops, but the vegetation on them provides cover and browse for wildlife and protects the watershed.

Henneke stony clay loam, 30 to 65 percent slopes (HcE).—This soil is along the eastern edge of mountainous areas.

Representative profile:

0 to 3 inches, reddish-brown, slightly hard stony clay loam that is dark reddish brown and friable when moist; weak, subangular structure; neutral.

3 to 22 inches, dark reddish-brown, hard gravelly to very gravelly clay that is dark reddish brown to dark red and firm when moist; moderate, medium to coarse, subangular blocky structure; neutral.

22 inches +, bluish-green, fractured serpentine rocks; in places in the upper part, soil material and roots are in cracks between the rocks; the rock is more massive with increasing depth.

The surface layer is strong-brown, reddish-brown, or dark-brown stony or rocky, gravelly or very gravelly clay loam. It has weak, granular or subangular blocky structure. The subsoil generally is dark brown, dark reddish brown, or dark red, but in places just above the parent rock it is dark olive brown. It is gravelly or very gravelly clay. The coarse fragments in the subsoil increase in size and amount with increasing depth. In areas near Black Diamond Ridge, most of the surface layer has been removed through erosion, and the clayey subsoil is exposed. Rock outcrops are common and occupy 2 to 10 percent of the surface in some areas, and especially on the very steep slopes. The soil is neutral throughout. Depth to serpentine bedrock generally is 15 to 25 inches, but it ranges from 10 to 12 inches in the eroded areas.

Permeability of this soil is slow. Runoff is rapid to very rapid, and the erosion hazard is severe to very severe. The available water holding capacity is 2 to 3 inches. Root penetration is shallow. Fertility is low because of the low ratio of calcium to magnesium in the soil. Grasses and forbs therefore grow poorly on this soil. Landslips occur in some areas. The parent rock is unstable, and roads are consequently difficult to maintain in the steeper areas.

Included with this soil are small areas of Rock land, serpentine, and of Stonyford soils.

Vegetation on this Henneke soil is mainly brush but includes some scattered Digger pines. The shrubs are predominantly whiteleaf manzanita, leather oak, hollyleaf ceanothus, and California holly. These plants provide cover and browse for wildlife and cattle and pro-

tect the watershed. Deer are the main wildlife. Capability unit VIIIs–9.

Henneke stony clay loam, 10 to 30 percent slopes (HcD).—On this soil runoff is medium, and the erosion hazard is moderate.

This soil is used the same as Henneke stony clay loam, 30 to 65 percent slopes. Capability unit VIIs–9.

Hillgate Series

The Hillgate series consists of nearly level to gently sloping, well-drained soils that have a weakly developed claypan. These soils formed in moderately fine textured alluvium. The alluvium is mainly from sedimentary and metasedimentary rocks of the Franciscan formation and of the Cretaceous period. Hillgate soils are on low terraces and old alluvial fans in the Sacramento Valley and in narrow valleys in the foothills at elevations of 100 to 1,000 feet. The vegetation is chiefly annual grasses and forbs, but a few blue oaks grow on the sloping areas in the foothills. The average annual precipitation is 16 to 25 inches.

The surface layer is pale-brown or brown loam that is slightly acid to medium acid. The subsoil is a brown light clay that grades to silty clay loam in the lower part; it is slightly acid. The substratum is light yellowish-brown, stratified clay loam, silt loam, and loam that is neutral to mildly alkaline. Lime, if present, generally is at a depth of more than 30 inches.

These soils are associated mainly with soils of the Arbuckle, Kimball, Myers, and Tehama series.

In dryfarmed areas Hillgate soils are used for small grain and annual range. The main irrigated crops are shallow-rooted field and forage plants. Small game birds and deer are the main kinds of wildlife.

Hillgate loam, 0 to 2 percent slopes (HgA).—This soil is on old alluvial fans and low terraces along the western edge of the Sacramento Valley and in the northeastern part of the county.

Representative profile:

0 to 15 inches, pale-brown to brown, hard loam that grades to heavy loam with increasing depth; dark brown and friable when moist; subangular blocky structure to massive; medium acid.

15 to 28 inches, brown, very hard light clay that is dark brown and firm when moist; coarse, angular to subangular blocky structure; slightly acid.

28 to 54 inches +, brown to light yellowish-brown, very hard, stratified silty clay loam, clay loam, and loam that is dark brown and yellowish brown and firm when moist; subangular blocky structure to massive; neutral to mildly alkaline.

The surface layer ranges from pale-brown or light yellowish-brown to brown loam or silt loam. The subsoil ranges from yellowish brown to brown or strong brown, and it generally is slightly reddish when moist. Its texture is light clay or silty clay. The substratum is loam, silt loam, silty clay loam, or clay and is somewhat stratified. It is pale brown, brown, or light yellowish brown and in many places is mottled with light gray. The surface layer is slightly acid to medium acid, and the subsoil is medium acid to neutral. The substratum is neutral to alkaline and in many places is calcareous at a depth of more than 30 inches.

Permeability of this soil is slow to very slow. Runoff is very slow, and erosion is slight or is not a hazard. The available water holding capacity is 5 to 7 inches. Root penetration is shallow to moderately deep. Fertility is low.

Included with this soil are small areas of Kimball loam and Tehama silt loam.

This Hillgate soil is used chiefly for dryfarmed small grain and annual range. If irrigation water is available, this soil is used for pasture plants, ladino clover, sorghum, corn, and alfalfa. In a few areas rice is grown. Capability unit IIIs–3.

Hillgate loam, 2 to 8 percent slopes (HgB).—This soil is in narrow valleys in the foothills. Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used mainly for dryfarmed small grain and annual range. Pheasant and deer are the principal wildlife. Capability unit IIIe–3.

Hillgate loam, moderately deep, 0 to 10 percent slopes (HhB).—This soil overlies sandstone and shale at a depth of 30 to 48 inches. Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used mainly for annual range. Small grain is grown in a few places. Capability unit IIIe–3.

Hillgate clay loam, 0 to 3 percent slopes (Hl).—The surface layer of this soil is finer textured than that in Hillgate loam, 0 to 2 percent slopes, but the two soils are otherwise similar. Use is also similar. Capability unit IIIs–3.

Hillgate gravelly loam, 0 to 2 percent slopes (HmA).—The surface layer of this soil is 15 to 30 percent gravel, but otherwise this soil is similar to Hillgate loam, 0 to 2 percent slopes. The subsoil is 10 to 20 percent gravel. The water-holding capacity is 4 to 6 inches.

This soil is used the same as Hillgate loam, 0 to 2 percent slopes. Capability unit IIIs–3.

Hillgate gravelly loam, water table, 0 to 2 percent slopes (Hn).—This soil is along narrow drainageways in the foothills. It has an intermittent water table but otherwise is similar to Hillgate gravelly loam, 0 to 2 percent slopes. The water table is at a depth of 3 to 5 feet during the rainy season and when surplus irrigation water is diverted into the drainageways. It rises and falls as the adjacent streams rise and fall.

This soil is used about the same as Hillgate gravelly loam, 0 to 2 percent slopes. Under irrigation, however, deep-rooted perennial crops, such as alfalfa, are not well suited, because of the intermittent water table. Annual crops are not affected by the water table. Capability unit IIIw–3.

Hillgate gravelly loam, 2 to 8 percent slopes (HmB).—On this soil runoff is slow to medium, and the erosion hazard is slight to moderate. This soil is used the same as Hillgate loam, 2 to 8 percent slopes. Capability unit IIIe–3.

Hillgate-Gullied land complex, 2 to 10 percent slopes (HgxB).—This complex consists of Hillgate loam that is cut by gullies and is steeper but otherwise is like Hillgate loam, 2 to 8 percent slopes. The gullies are 4 to 7 feet deep.

Most of this complex is used for annual range, but a few areas are used for dryfarmed grain. The gullies cannot be crossed with farm machinery. They also make it difficult for cattle to graze the areas. Pheasant and deer are the principal wildlife. Capability unit IIIe–3.

Hillgate-Gullied land complex, gravelly, 2 to 10 percent slopes (HmxB).—This complex consists of Hillgate gravelly loam that is cut by gullies and is steeper but otherwise is similar to Hillgate gravelly loam on slopes of 2 to 8 percent. The gullies are 4 to 7 feet deep and are at intervals of 300 to 1,000 feet.

This soil is used the same as Hillgate loam, 2 to 8 percent slopes. Capability unit IIIe–3.

Hillgate-Gullied land complex, moderately deep, 2 to 10 percent slopes (HhxB).—This complex consists of Hillgate loam that is more sloping and is cut by gullies but otherwise is similar to Hillgate loam, moderately deep, 0 to 10 percent slopes. The gullies are 4 to 7 feet deep and are at intervals of 300 to 1,000 feet or more.

This complex is used the same as Hillgate-Gullied land complex, 2 to 10 percent slopes. Capability unit IIIe–3.

Hohmann Series

The Hohmann soils are moderately steep to very steep, well drained, and rocky. These soils formed in material from basic metavolcanic rock. They are on mountainous slopes under mixed stands of conifers and hardwoods at elevations of 3,500 to 5,000 feet. The average annual precipitation is 35 to 55 inches, and much of it falls as snow.

The surface layer is reddish-gray, gravelly heavy loam or light clay loam, and the subsoil is reddish to pinkish-gray gravelly clay loam. These soils are moderately deep or deep and are gravelly or cobbly throughout. Rock outcrops are common. Reaction is slightly acid to medium acid and generally is slightly more acid with increasing depth.

Hohmann soils are in the same general area as the Hugo, Josephine, and Neuns soils. In contrast to the closely associated Neuns soils, Hohmann soils are reddish gray or purplish in color.

These soils are well suited to trees grown for timber. The trees also provide food and cover for wildlife and protect the watershed.

Hohmann rocky loam, 30 to 65 percent slopes (HoE).—This moderately deep soil is on long, rough, mountainous slopes. Rock outcrops are common and occupy as much as 25 percent of the surface.

Representative profile:

2½ inches to 0, fresh and partly decomposed, loose litter made up of conifer needles, oak and shrub leaves, and twigs.

0 to 4 inches, reddish-gray, slightly hard gravelly heavy loam to gravelly light clay loam that is dark reddish gray and friable when moist; medium, granular structure; slightly acid.

4 to 29 inches, reddish-gray to pinkish-gray, hard gravelly clay loam that is dark reddish gray to reddish gray and slightly firm when moist; the gravel and angular cobblestones increase in size and amount with increasing depth; massive; slightly acid to medium acid.

29 inches +, fractured, hard, very slightly weathered, purplish basic metavolcanic rocks; in places soil material and roots are in cracks between the rocks.

The surface layer generally is reddish gray, but in places it is dark reddish gray or pinkish gray. The color of the subsoil is similar to that of the surface layer or is slightly lighter, but it is dominantly reddish gray or pinkish gray.

This soil is medium textured to moderately fine textured but generally is slightly finer textured with increasing depth. Gravel and cobblestones make up from 25 to 50 percent of the profile, by volume. Rock outcrops generally occupy less than 25 percent of the surface, but in some places they occupy as much as 50 percent. Depth generally is 24 to 40 inches, but in some places it is as shallow as 20 inches or as deep as 50 inches.

Permeability is moderate. Runoff is medium to rapid, and the erosion hazard is severe to very severe. The available moisture holding capacity is 3 to 5 inches. Root penetration is moderately deep. In a few places small areas of reddish-brown soils are included.

This Hohmann soil is used mainly for timber. Ponderosa pine, Douglas-fir, and sugar pine generally are the main trees in the stands, but hardwoods and shrubs grow in some places. Dense stands of black oak or brush grow in a few areas. This soil also is suitable for use as watershed and wildlife areas. The trees and shrubs that grow on these soils protect the watershed and in places provide cover and browse for wildlife. Capability unit VIIs–7.

Hohmann rocky loam, deep, 10 to 30 percent slopes (HpD).—This soil is deeper and less stony than Hohmann rocky loam, 30 to 65 percent slopes. Rock outcrops generally occupy less than 20 percent of the surface. Depth to parent rock is 36 to 54 inches. The available water holding capacity is 4 to 6 inches. Root penetration is deep. Runoff is medium, and the erosion hazard is moderate.

This soil is well suited to trees. Conifers on this soil are mainly ponderosa pine and sugar pine. The brush in the understory is mainly deer brush and hoary manzanita. The areas are also good for wildlife, and the trees and brush provide cover and browse for them. Capability unit VIs–7.

Hugo Series

The Hugo series consists of moderately deep or deep, moderately steep to very steep soils that are well drained. These soils formed under conifers in material from sandstone and shale of the Franciscan formation. They are on mountains in the western part of the county, near Sheetiron Mountain and Lee Logan Camp. Elevations range from 3,000 to 5,000 feet. The average annual precipitation is 35 to 55 inches, and much of it falls as snow.

The surface layer is grayish brown and is medium in texture. It overlies brown or light yellowish-brown subsoil that is also medium in texture. The surface layer is medium acid, and the subsoil is medium acid to strongly acid. These layers contain gravel and stones in some places. In a few areas rocks crop out.

These soils are in the same general area as the Sheetiron and Josephine soils, which formed under timber in material from metasedimentary and sedimentary rocks. They are also near the Neuns soils, which formed in material from metavolcanic rock. At lower elevations Hugo soils are near the shallow Maymen soils, which are under brush, and the Millsholm soils, which are under grass.

Hugo soils are used primarily for timber. They are also used for wildlife and watershed areas and for recreation, mainly camping and hunting.

Hugo loam, moderately deep, 30 to 50 percent slopes (HtE).—This soil occupies several areas near Lee Logan Camp and The Pocket, south of Sheetiron Mountain.

Representative profile:

1½ inches to 0, fresh and partly decomposed litter made up of conifer needles, hardwood leaves, and twigs.
0 to 5 inches, grayish-brown, soft loam that contains a few pebbles; very dark grayish brown and very friable when moist; moderate, fine, granular structure; medium acid.
5 to 13 inches, brown, slightly hard loam that contains a few pebbles; dark brown and friable when moist; moderate, medium, granular structure; medium acid.
13 to 29 inches, light yellowish-brown, slightly hard, gravelly heavy loam that is yellowish brown and slightly firm when moist; weak, subangular blocky structure; medium acid.
29 inches +, fractured and partly weathered, fine-grained sandstone and shale; in places soil material and large roots are in the cracks between the rocks.

The surface layer generally is grayish brown, brown, or pale brown. The subsoil is lighter colored and grades from brown or pale brown in the upper part to very pale brown, light yellowish brown, or pale yellow in the lower part. Reaction is slightly acid to medium acid in the surface layer and medium acid to strongly acid in the subsoil. Texture ranges from fine sandy loam or loam to light clay loam, and it generally is somewhat finer with increasing depth.

In places the profile contains gravel, which generally increases in size and amount with increasing depth. In many places just above the parent rock, angular cobblestones are present. In some places a few cobblestones are on the surface, and in a few places rock outcrops are common. Depth to weathered parent rock ranges from 20 to 40 inches.

Permeability of this soil is moderate to moderately rapid. Runoff is medium to rapid, and the erosion hazard is severe. Root penetration is moderately deep to deep, and in places large tree roots are in cracks in the parent rock. The available water holding capacity is 4 to 6 inches. Small areas of Josephine soils are included.

This Hugo soil is well suited to timber. The stands are open to semidense and consist of ponderosa pine, Douglas-fir, and black oak. In places the cover consists of madrone and an understory of low shrubs, mainly deer brush, hoary manzanita, and common manzanita. This soil is also used for watershed and wildlife areas and for recreational purposes. Capability unit VIe–1.

Hugo loam, moderately deep, 10 to 30 percent slopes (HtD).—In some places this soil has a few angular cobblestones on the surface, and in a few places rocks crop out. Runoff is medium, and the erosion hazard is moderate.

This soil is well suited to trees. Some areas have an understory of brush. This soil is also used for wildlife and watershed areas and for recreational purposes. Capability unit IVe–4.

Hugo loam, moderately deep, 50 to 65 percent slopes (HtF).—In this soil angular cobblestones generally are more numerous than in less steep Hugo soils, and more rocks crop out. Runoff is very rapid, and the erosion hazard is very severe.

This soil is used chiefly for trees. It is also used for wildlife and watershed areas and for recreational purposes. Capability unit VIIe–1.

Hugo loam, 20 to 50 percent slopes (HrE).—This soil occupies a small acreage in The Pocket, south of Sheetiron Mountain. Depth to weathered parent rock is 40 to 54 inches. The available water holding capacity is 6 to 8 inches. Runoff is medium to rapid, and the erosion hazard is moderate to severe.

This soil is well suited to trees. Capability unit VIe–1.

Hulls Series

In the Hulls series are strongly sloping to very steep, well-drained gravelly loams. These soils formed in material from metamorphosed sedimentary rocks, predominantly chlorite-sericite schist banded with veins of quartzite. Hulls soils are in mountainous areas, chiefly in the northwest corner of the county at elevations of 3,500 to 6,500 feet. The vegetation is mainly grass and bracken fern but includes some scattered Brewer oaks. The average annual precipitation is 40 to 60 inches, and much of it falls as snow.

The surface layer, a gray gravelly loam, overlies light brownish-gray or grayish-brown gravelly or very gravelly loam. The soil material in these layers has a silvery sheen and feels like talc. The soils are medium acid or strongly acid throughout. Depth to parent rock generally is 20 to 40 inches. Rocks crop out in a few places.

These soils generally are associated with Masterson and Sheetiron soils at the higher elevations and with Maymen soils at the lower elevations.

Hulls soils are used mainly for grazing cattle in summer. They are also used as watershed areas, and in places they provide forage and cover for deer and other wildlife.

Hulls gravelly loam, 30 to 50 percent slopes (HuE).—On this moderately deep soil, the vegetation is mainly grass and bracken fern but includes scattered thickets of Brewer oak.

Representative profile:

0 to 18 inches, gray, soft gravelly loam that is very dark gray and very friable when moist; has a silvery sheen and feels like talc; the gravel is fragments of schist and quartzite; granular structure; medium acid to strongly acid.
18 to 35 inches, light brownish-gray, slightly hard gravelly loam that is dark grayish brown and friable when moist; has a silvery sheen and feels like talc; weak, fine, subangular blocky structure; medium acid.
35 inches +, strongly folded and fractured, gray chlorite-sericite schist banded with veins of whitish quartzite; in the upper part soil material is in the cracks between the rocks.

In color the surface layer ranges from gray to grayish brown or light brownish gray, and the subsoil from light brownish gray to light gray. The soils generally are medium acid or strongly acid throughout. The texture is gravelly or very gravelly loam or light clay loam. The gravel is angular fragments of schist and quartzite, and it generally increases in size and amount with increasing depth. In many places a thin layer of gravel is on the surface. In small areas rocks crop out. Depth to parent material ranges from 20 to 40 inches, but it is dominantly 24 to 36 inches.

Permeability of this soil is moderately rapid. Runoff is rapid, and the erosion hazard is high. The available water holding capacity is 4 to 5 inches. Root penetration is moderately deep, and fertility is moderate.

Included with this soil are small areas of Masterson, Maymen, and Sheetiron soils.

This Hulls soil is limited in use because the areas are at high elevations. It is used mainly as summer range

for cattle. It also is used as watershed areas and provides forage and cover for wildlife, mainly deer and mountain quail. In most areas small landslips are common. In many places road cuts in this soil are unstable and slump downslope. Roads on this soil therefore require frequent maintenance. Capability unit VIe–8.

Hulls gravelly loam, 10 to 30 percent slopes (HuD).—This soil generally is more than 30 inches deep and in some areas is as much as 45 inches deep. Runoff is medium, and the erosion hazard is moderate.

Included with this soil are small areas of Sheetiron and Tyson soils.

This Hulls soil is used chiefly as summer range for cattle. It is also used for watershed areas and provides cover and forage for wildlife. Capability unit VIe–8.

Hulls gravelly loam, 50 to 65 percent slopes (HuF).—This soil has somewhat uneven slopes because of landslips and a few rock outcrops. Depth to parent rock is 18 to 30 inches. Runoff is rapid to very rapid, and the erosion hazard is very severe.

Included with this soil are small areas of Sheetiron, Maymen, and Tyson soils.

This Hulls soil is used for summer range, but grazing is not so effective as on less steep Hulls soils. It is also used for watershed areas and habitats for wildlife. Capability unit VIIe–8.

Jacinto Series

The Jacinto soils are very deep, nearly level to gently sloping, well drained, and moderately coarse textured. These soils formed under annual grasses and forbs in wind-laid materials derived from sandy and gravelly channel deposits. These channel materials washed from soils on sedimentary and metasedimentary rocks in the western part of the county. Jacinto soils are in the northeastern part of the county on low, gently undulating ridges on the south side of the old abandoned streambeds of Stony Creek. Elevations are 150 to 250 feet. The average annual rainfall is 17 to 20 inches.

The surface layer, a light brownish-gray or grayish-brown fine sandy loam that is slightly acid, overlies a similar colored, or browner, heavy fine sandy loam that is neutral. Below is light olive-brown or pale-brown fine sandy loam that is mildly alkaline. Fallowed areas or areas barren of vegetation are subject to wind erosion.

These soils are associated with the gravelly Cortina soils and the medium-textured Tehama and Wyo soils.

Most areas of Jacinto soils are irrigated and used mainly for alfalfa, almonds, olives, oranges, milo, corn, sudangrass and ladino clover. Areas that are not irrigated are dryfarmed to barley or used for annual range.

Jacinto fine sandy loam, 0 to 2 percent slopes (JcA.)—This soil is on low ridges in the Loam Ridge-Plaza District of the county.

Representative profile:

0 to 15 inches, grayish-brown, slightly hard fine sandy loam that is dark grayish brown and friable when moist; massive; slightly acid.
15 to 38 inches, grayish-brown to brown, hard, heavy fine sandy loam that is fine sandy loam in the lower part and is dark grayish brown and friable when moist; massive; neutral to mildly alkaline.
38 to 60 inches +, light olive-brown, slightly hard fine sandy loam that is olive brown and friable when moist; massive; mildly alkaline.

The surface layer is 12 to 22 inches thick. It is light brownish-gray or grayish-brown loamy fine sand or fine sandy loam and is slightly acid to neutral. The subsoil is grayish-brown, dark grayish-brown, or brown heavy fine sandy loam or light sandy clay loam, and it is neutral to mildly alkaline. The substratum is light olive-brown, brown, or light yellowish-brown fine sandy loam or loamy fine sand and is mildly alkaline.

Permeability of this soil is moderate. Runoff is slow, and the erosion hazard is slight. The available water holding capacity is 8 to 10 inches. Root penetration is deep, and fertility is moderate.

This soil is used for a variety of row, field, and orchard crops. Irrigated areas are used for almonds, olives, oranges, alfalfa, corn, milo, sugarbeets, ladino clover, and pasture plants. Areas that are not irrigated are dryfarmed to barley or are used for annual range. A plowpan or traffic pan forms readily if this soil is tilled when it is too wet. Capability unit I–1.

Jacinto fine sandy loam, 2 to 8 percent slopes (JcB).—This soil is in narrow areas on breaks between nearly level areas of Jacinto soils, on low ridges, and Cortina soils, in old stream channels. Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil generally is dryfarmed to small grain or used for pasture. Most areas are too small and narrow for terracing or for sprinkler irrigation. Capability unit IIe–1.

Josephine Series

The Josephine series consists of moderately deep and deep, well-drained, moderately steep to steep gravelly soils. These soils formed in material from schistose and partly metamorphosed sedimentary rocks. They are in mountainous areas in the western part of the county at elevations of 1,500 to 4,500 feet. The vegetation is mainly forests of various kinds of conifers but includes some hardwoods and an understory of shrubs. In places at lower elevations, dense stands of knobcone pine or brush make up the vegetation. The average annual rainfall is 30 to 50 inches.

The surface layer is pale-brown or brown gravelly loam that is slightly acid to medium acid. The subsoil, a reddish-yellow, yellowish-red, or red gravelly clay loam or light clay, is medium acid to strongly acid. Depth to the tilted and strongly folded bedrock ranges from 30 to 66 inches. Rocks crop out in a few places.

These soils are associated with the shallow to moderately deep Sheetiron soils at higher elevations and the very shallow and shallow, brush-covered Maymen and Los Gatos soils at lower elevations.

Josephine soils are well suited to trees. Many areas have dense stands of brush and knobcone pine on them, and these are used for wildlife habitats and watershed areas. A few areas are in apple orchards.

Josephine gravelly loam, 30 to 50 percent slopes (JgE).—This is the most extensive unit of the Josephine soils mapped in the county.

Representative profile:

1 inch to 0, fresh and partly decomposed litter consisting of conifer needles, hardwood leaves, and twigs.
0 to 4 inches, pale-brown, soft gravelly loam that is dark brown and very friable when moist; medium, granular structure; slightly acid.

4 to 11 inches, light-brown to brown, slightly hard gravelly light clay loam that is reddish brown and friable when moist; massive; medium acid.
11 to 25 inches, yellowish-red to red, hard gravelly clay that is yellowish red to dark red and firm when moist; massive; medium acid to strongly acid.
25 to 46 inches, similar to the 11- to 25-inch horizon but consists of very gravelly clay; medium acid.
46 inches +, well fractured and strongly folded, partly weathered sericite schist; in places soil material and roots are along cracks between the rocks.

The surface layer is pale brown, light brown, or brown to reddish brown, and the subsoil is reddish yellow or yellowish red to red. Texture ranges from gravelly loam and light clay loam in the surface layer to gravelly or very gravelly heavy clay loam or clay in the subsoil. Gravel, by volume, makes up 20 to 40 percent of the surface soil and 35 to 60 percent of the subsoil. The gravel generally is less than 1 inch in diameter. It consists of fragments of quartzite or schist that have seams of quartzite. Depth to weathered bedrock generally is 36 to 48 inches, but in some places it ranges from less than 30 to more than 60 inches within a short distance. Reaction is slightly acid or medium acid in the surface soil and medium acid to very strongly acid in the subsoil.

Permeability is moderate to moderately rapid in the surface layer and moderate to moderately slow in the subsoil. The available water holding capacity is 5 to 7 inches. Roots penetrate the depth of the profile and follow along cracks into the fractured parent rock. Runoff is medium to rapid, and the erosion hazard is high. Fertility is moderate.

Included with this soil are small areas of Sheetiron soils at higher elevations and less extensive areas of Maymen and Los Gatos soils at lower elevations.

This Josephine soil is well suited to trees. Many areas of this soil at lower elevations support dense stands of various kinds of shrubs and knobcone pines that include only a few commercial conifers. These are used mainly for watershed and wildlife areas. Capability unit VIe–4.

Josephine gravelly loam, 10 to 30 percent slopes, eroded (JgD2).—From 25 to 50 percent of the surface layer of this soil has been removed through sheet erosion. Depth to weathered bedrock ranges from 18 to 36 inches. The water-holding capacity is 3 to 4 inches. Runoff is medium, and the erosion hazard is moderate to high.

All of this soil is used for wildlife and watershed areas. Dense stands of brush that include a few knobcone pines cover this soil. Capability unit IVe–4.

Josephine gravelly loam, 30 to 50 percent slopes, eroded (JgE2).—From 25 to 50 percent of the surface layer of this soil has been removed through erosion. Depth to weathered bedrock generally is less than 36 inches. The water-holding capacity is 3 to 5 inches. Runoff is medium to rapid, and the erosion hazard is high.

Included with this soil are small areas of deep, reddish soils. Also included are small areas of very shallow and shallow Maymen and Los Gatos soils and of less steep Josephine soils.

All areas of Josephine gravelly loam, 30 to 50 percent slopes, eroded, are under a dense cover of brush and knobcone pines. They are used as wildlife and watershed areas. Capability unit VIe–4.

Josephine-Maymen gravelly loams, 30 to 50 percent slopes (JmE).—This mapping unit generally is on slopes just below areas where commercial conifers grow. It consists of areas of Josephine gravelly loam, 30 to 50 percent slopes, and of Maymen gravelly loam, shallow over schist, on 30 to 50 percent slopes. Either soil may make up from 40 to 60 percent of any one area.

Included with these soils are small areas of shallow Los Gatos soils and of deep, reddish soils.

The soils in this mapping unit are well suited to watershed areas and wildlife habitats. The vegetation is mainly dense stands of brush and knobcone pines, but oaks grow in some places. Capability unit VIIIs–8.

Josephine-Sheetiron gravelly loams, 30 to 50 percent slopes (JsE).—This mapping unit consists of Josephine gravelly loam, 30 to 50 percent slopes, and Sheetiron gravelly loam, 30 to 50 percent slopes. Either soil may make up from 40 to 60 percent of any one area.

Included with these soils, generally on the more gentle slopes, are small areas of deep, reddish soils.

The soils in this mapping unit are well suited to trees. Ponderosa pine and Douglas-fir are the main trees in the commercial stands, but the stands include some black oaks and an understory of brush. A few areas have a dense cover of brush. This mapping unit is also used for watershed and wildlife areas and as hunting areas for sportsmen. Capability unit VIIIs–8.

Kimball Series

The Kimball series consists of nearly level to gently sloping, well-drained soils that have a claypan. These soils formed in mixed alluvium derived mainly from metasedimentary, sedimentary, and metavolcanic rocks. They are on old alluvial fans and low terraces. The areas are most extensive in the northeastern part of the county, but small areas are in narrow valleys in the foothills in the central part of the county. Elevations range from 100 to 1,200 feet. The vegetation is mainly annual grasses and forbs but includes a few scattered blue oaks. The average annual rainfall is 16 to 25 inches.

The surface layer, a brown loam that is slightly acid to medium acid, is 10 to 20 inches thick. It abruptly overlies reddish-brown clay that is slightly acid to neutral. The substratum is coarser textured than the subsoil and is somewhat stratified. It is brown, reddish brown, or yellowish brown in color, is loam or clay loam to sandy clay loam in texture, and is neutral to mildly alkaline. In places the substratum is gravelly. In some areas the soil profile is 10 to 25 percent gravel, by volume. The soil generally is noncalcareous throughout the profile, but in places the substratum is intermittently calcareous.

These soils are associated with soils of the Arbuckle and Hillgate series in the northeastern part of the county.

Kimball soils are used mostly for range, dryfarmed small grains, and irrigated, shallow-rooted field and forage crops. Oranges are grown in some places.

Kimball loam, 0 to 2 percent slopes (Kb).—This soil is on a low terrace in the district of Capay. The surface is smooth.

Representative profile:

0 to 16 inches, brown near reddish-brown, hard loam that is dark brown near dark reddish-brown and friable when moist; a few pebbles of quartzite and chert; massive; slightly acid to neutral.
16 to 27 inches, reddish-brown, extremely hard clay that is dark reddish brown or yellowish red and very firm when

moist; medium, prismatic structure, but angular blocky with increasing depth; slightly acid.

27 to 60 inches +, reddish-brown, brown, and light yellowish-brown, hard clay loam and sandy clay loam that is yellowish red, dark brown, and yellowish brown and firm when moist; gravelly in places; massive; neutral to mildly alkaline.

The surface layer generally is brown but ranges to reddish brown or reddish yellow. It is loam or fine sandy loam and in places is as much as 10 percent gravel. Reaction is slightly acid or medium acid. The surface layer abruptly overlies a reddish-brown or yellowish-red, very dense clay subsoil that generally is free of gravel and is slightly acid to neutral. The subsoil generally is 10 to 18 inches thick. The substratum is lighter colored than the subsoil and is coarser textured. It is somewhat stratified with gravelly and nongravelly materials that are medium textured and moderately fine textured. It is neutral to mildly alkaline and generally is free of carbonates. Low hummocks occur in places in undeveloped areas.

Permeability of this soil is very slow. Runoff is slow, shallow, though in a few places roots follow cracks into the claypan. The available moisture holding capacity is 3 to 5 inches. Fertility is low.

Included with this soil are small areas of Moda loam, which is like Kimball loam but also has a hardpan.

This Kimball soil is well suited to milo (fig. 5), corn, sudangrass, ladino clover, irrigated pasture plants, and other shallow-rooted field and forage crops. In some areas oranges and alfalfa are grown, but in these areas careful management is needed to prevent development of a perched water table above the claypan. Areas that are not irrigated are used mainly for range, barley, and wheat. Capability unit IIIs–3.

Kimball loam, 2 to 10 percent slopes (KbB).—Most of this soil is in valleys in the foothills of the county. Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used mainly for range and dryfarmed barley or wheat. Stands of blue oaks are on some areas used for range. Deer and small game birds, chiefly quail and dove, are the main kinds of wildlife. Capability unit IIIe–3.

Figure 5.—**Milo, a shallow-rooted field crop, is well suited to Kimball loam.**

Kimball gravelly loam, 0 to 2 percent slopes (KmA).—This soil generally is associated with Arbuckle gravelly loams and Kimball loams. It is 15 to 25 percent gravel throughout. The available water holding capacity is 3 to 4 inches.

This soil is used the same as Kimball loam, 0 to 2 percent slopes. Capability unit IIIs–3.

Kimball gravelly loam, 2 to 10 percent slopes (KmB).—Most of this soil is in small valleys in the foothills in the central part of the county. Runoff is slow to medium, and the erosion hazard is slight to moderate.

This soil is used for range and dryfarmed barley and wheat. A few areas have deep gullies. Capability unit IIIe–3.

Kimball-Gullied land complex, 2 to 10 percent slopes (KnB).—This complex consists of Kimball loam, 2 to 10 percent slopes, that is cut by gullies. The gullies are 4 to 7 feet deep and are at intervals of 500 to 1,000 feet.

This complex is used the same as Kimball loam, 2 to 10 percent slopes. Capability unit IIIe–3.

Landlow Series

In the Landlow series are nearly level, somewhat poorly drained soils that have a hardpan. These soils formed in moderately fine textured and fine textured alluvium derived from basic igneous rocks, mainly andesitic breccia and basalt. They are in basins in valley plains east of the Sacramento River at elevations of 65 to 100 feet. The vegetation is mainly annual grasses and forbs, but tules and other plants that tolerate wetness grow along sloughs that drain areas of these soils. The average annual rainfall is 18 to 20 inches.

The surface layer is dark grayish-brown, fine-textured material that is slightly acid to neutral. The subsoil is brown or dark brown, is fine textured, and is mildly alkaline to moderately alkaline and calcareous. It abruptly overlies a substratum of variable hardness and thickness that is cemented with lime and silica. Depth to the cemented substratum generally is 30 to 45 inches. Small pellets of iron and manganese are common in the lower part of the surface layer and in the subsoil. In areas used for rice, strong-brown mottles are prominent throughout the profile.

Much of the acreage of these soils is used for rice and irrigated pasture. Dryfarmed crops are mainly milo, barley, and safflower.

Landlow clay (0 to 1 percent slopes) (La).—This moderately deep to deep soil is in basins east of the Sacramento River.

Representative profile in a fallowed ricefield:

0 to 26 inches, dark grayish-brown, very hard clay that is very dark grayish brown and very firm when moist; common, strong-brown mottles; very coarse, prismatic and medium to coarse, blocky structure; slightly acid, but neutral with increasing depth; a few pellets of iron and manganese in the lower part; very dense plowpan at a depth of 9 to 17 inches.

26 to 35 inches, brown, hard clay that is dark brown and firm when moist; a few, strong-brown mottles; massive; mildly alkaline and slightly calcareous; lime is segregated in soft white masses; a few pellets of iron and manganese.

35 to 60 inches +, mottled brown and pale-brown material cemented with lime and silica; the uppermost 2 inches is

an indurated, cemented hardpan; massive; moderately alkaline and strongly calcareous.

The surface soil is dark grayish-brown or dark-brown silty clay or clay that is slightly acid to neutral. The subsoil ranges from brown or dark brown to strong brown silty clay or clay. It is mildly alkaline to moderately alkaline and is slightly calcareous to moderately calcareous. The substratum ranges from 5 to 25 inches in thickness, is weakly to strongly cemented with lime and silica, and the uppermost 2 to 3 inches generally is indurated. Cementation and hardness of the substratum decrease with increasing depth. Depth to the hardpan generally is 30 to 45 inches, but in some areas it is as shallow as 24 inches or is more than 54 inches deep. In areas used for rice, variable amounts of strong-brown mottles occur throughout the profile, and in places gley spots are above the substratum.

Permeability of this soil is very slow. Root penetration is moderately deep to deep. The hardpan restricts movement of water and development of roots. Runoff is very slow, and erosion is very slight or is not a hazard. The available water holding capacity is 6 to 8 inches. During the rice-growing season a perched water table occurs above the hardpan and in fields that border areas flooded for rice.

Much of this soil is used for rice. Minor irrigated crops are pasture plants and corn. Dryfarmed crops are mainly barley, safflower, and milo. Areas of this soil also are used in fall for hunting, mainly of pheasant and waterfowl. Capability unit IIIw–5.

Landlow clay loam (0 to 1 percent slopes) (Lc).—This deep soil is similar to Landlow clay, but the uppermost 6 to 12 inches is heavy clay loam. Depth to the cemented hardpan generally is more than 40 inches. Use is the same as for Landlow clay. Capability unit IIIw–5.

Lodo Series

In the Lodo series are rolling to steep, very shallow, somewhat excessively drained soils. These soils formed in material from hard shale of the Knoxville formation and other similar formations. They occupy an area 3 to 5 miles wide along the western edge of the foothills at elevations of 500 to 2,000 feet. The area extends northward from the southwestern part of the county, near the Colusa County line, to Newville, near the Tehama County line. The vegetation is mainly grasses or grasses and oaks, but a few shrubs or junipers grow on some areas. The average annual precipitation ranges from 18 to 25 inches.

These soils typically consist of grayish-brown or pale-brown, very friable fine shaly loam or clay loam. They have weak structure, are slightly acid or neutral throughout, and abruptly overlie dark-gray shale bedrock at a depth of 5 to 10 inches. The shale is steeply tilted and warped and weathers to small angular fragments.

In many places Lodo soils are associated with the shallow Millsholm and Millsap soils. They are also associated with the gravelly Newville soils, on dissected high terraces, and with the deep Tehama soils, on alluvial fans and low terraces.

Lodo soils are used chiefly for range, but a few areas are dryfarmed to grain. Because of shallowness and low water-holding capacity, Lodo soils dry out early in spring.

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Soils of the Lodo series are mapped only as complexes with Gullied land and with the Millsap and Tehama soils. The Millsap and Tehama soils are described under their respective series.

Lodo-Gullied land complex, 10 to 30 percent slopes (LmD).—This complex consists of Lodo shaly clay loam that is cut by gullies. The gullies are 2 to 5 feet deep and are at intervals of 300 to 1,000 feet.

Representative profile:

0 to 7 inches, grayish-brown, slightly hard fine shaly clay loam that is dark grayish brown and very friable when moist; weak, subangular blocky structure; slightly acid.
7 inches +, hard, dark-gray shale; highly fractured in the uppermost few inches but more massive with increasing depth.

This soil ranges from pale brown to grayish brown in color, according to the amount of shale fragments in the soil. Texture ranges from fine shaly loam to shaly clay loam. Depth varies within a short distance but seldom is more than 10 inches. Reaction is slightly acid to neutral throughout. The soil is moderately permeable throughout, but the underlying shale bedrock is impervious to movement of water and penetration of roots. The water-holding capacity is 1 to 2 inches. Runoff is medium, and the erosion hazard is high.

A few areas of this complex are dryfarmed to barley, but these soils are better suited to pasture or range than to other uses. Capability unit VIIs–8.

Lodo-Gullied land complex, 30 to 50 percent slopes (LmE).—Except for steeper slopes, this complex is like Lodo-Gullied land complex, 10 to 30 percent slopes. Runoff is rapid, and the erosion hazard is very high.

All of this complex is used for range. Capability unit VIIs–8.

Lodo-Millsap-Gullied land complex, 10 to 30 percent slopes (LoD).—This complex consists of Lodo shaly clay loam like that in Lodo-Gullied land complex, 10 to 30 percent slopes, and of Millsap loam, which is similar but is less steep than that in Millsap loam, 30 to 50 percent slopes. Each soil may make up from 40 to 60 percent of any one area. The Lodo soil normally is on the droughty, south-facing slopes and the ridgetops, and the Millsap soil is on the more humid, north-facing slopes. Runoff is medium to rapid. The erosion hazard is moderate to high.

All of this complex is used for range. Capability unit VIe–3.

Lodo-Millsap-Gullied land complex, 30 to 65 percent slopes (LoE).—Except for steeper slopes, this complex is similar to Lodo-Millsap-Gullied land complex, 10 to 30 percent slopes. On the Lodo soil the cover is grasses or open stands of trees and grasses, but that on the Millsap soil is trees and grasses with moderately dense stands of blue oaks and shrubs. Runoff is rapid, and the erosion hazard is severe to very severe.

All of this complex is used for pasture or range. Capability unit VIIe–3.

Lodo-Tehama clay loams, 10 to 30 percent slopes (LsD).—From 70 to 90 percent of this mapping unit consists of Lodo shaly clay loam, and the rest is Tehama clay loam. The Lodo soil is very shallow and is on rolling to hilly, convex slopes. The Tehama soil is deep and occupies the less steep, concave toe slopes and swales.

The soils in this mapping unit are used about the

same as Lodo-Gullied land complex, 10 to 30 percent slopes. A few areas are dryfarmed to barley. Although the Tehama soil makes up less than 30 percent of this unit, it produces as much as 50 percent of the forage produced on the areas. Capability unit VIIs–8.

Lodo-Tehama clay loams, 30 to 50 percent slopes (LsE).—This mapping unit is similar to Lodo-Tehama clay loams, 10 to 30 percent slopes, but slopes are steeper. From 80 to 95 percent of this unit is Lodo clay loam, and the rest is Tehama clay loam. Runoff is rapid, and the erosion hazard is severe.

These soils are too steep and shallow for farm crops and are all used for range. Capability unit VIIs–8.

Lodo-Tehama-Gullied land complex, 10 to 30 percent slopes (LtD).—This complex occupies large areas along the western edge of the foothills between Stonyford and Newville. The areas are quite irregular in size and shape. The soils are cut by gullies but otherwise are like Lodo-Tehama clay loams, 10 to 30 percent slopes. The gullies are 3 to 5 feet deep and are along natural drainageways in the Tehama soil.

These soils are used the same as Lodo-Tehama clay loams, 10 to 30 percent slopes, but the deep gullies limit grazing. Capability unit VIIs–8.

Lodo-Tehama-Gullied land complex, 30 to 50 percent slopes (LtE).—The soils in this complex are cut by gullies but otherwise are like those in Lodo-Tehama clay loams, 30 to 50 percent slopes. The gullies are 3 to 5 feet deep and are at intervals of 300 to 1,000 feet. Runoff is rapid, and the erosion hazard is very high.

These soils are used the same as Lodo-Gullied land complex, 30 to 50 percent slopes. Capability unit VIIs–8.

Los Gatos Series

The Los Gatos series consists of rolling to very steep, well-drained to somewhat excessively drained, gravelly soils. These soils are shallow or moderately deep over sericite schist and weakly metamorphosed sandstone and shale parent rock. They are in mountainous areas at elevations of 1,500 to 4,000 feet. The native vegetation was dense stands of brush, in which chamise, ceanothus, manzanita, chaparral oaks, and mountain mahogany were dominant. The grasses in the understory were sparse and were mainly annual fescues and bromes. The average annual precipitation is 25 to 45 inches.

The surface layer is brown gravelly loam, and the subsoil is brown or reddish-brown gravelly clay loam. Depth to folded and fractured sericite schist or slightly metamorphosed sandstone and shale generally is 15 to 30 inches. Reaction is medium acid or strongly acid throughout.

These soils are associated chiefly with soils of the Josephine, Maymen, and Parrish series.

Los Gatos soils are used mainly for water supply and for wildlife habitats. A few areas have been cleared of brush and converted to grass for grazing.

Los Gatos gravelly loam, schist bedrock, 30 to 50 percent slopes (LvE).—This moderately deep soil is on mountain slopes.

Representative profile:

0 to 10 inches, brown, hard gravelly loam that is dark brown and friable when moist; granular structure; strongly acid.
10 to 22 inches, brown to reddish-brown, hard gravelly clay loam that is yellowish red and firm when moist; massive; strongly acid.
22 inches +, folded and fractured sericite schist bedrock; in places soil material and roots are in the cracks between the rocks.

The surface layer is brown, dark-brown, or grayish-brown gravelly heavy loam or clay loam, and the subsoil is brown, strong-brown, or reddish-brown gravelly heavy loam or clay loam. The gravel content is 20 to 35 percent in the surface layer and 30 to 50 percent in the subsoil. Depth to bedrock is 15 to 30 inches.

This soil is well drained. Permeability is moderate, runoff is rapid, and the erosion hazard is severe. The available water holding capacity is 2 to 4 inches. Fertility is low to moderate. Root penetration is shallow to moderately deep.

Included with this soil are small areas of Maymen gravelly loam, of schist bedrock, and of Parrish gravelly loam.

This Los Gatos soil is used for water supply and for wildlife habitats. Deer are the principal wildlife. If the vegetation on this soil is burned off, annual grasses and forbs grow for several years before brush reclaims the site. These burned areas provide more browse and forage for livestock and wildlife than areas not burned. Capability unit VIIe–8.

Los Gatos gravelly loam, schist bedrock, 10 to 30 percent slopes (LvD).—On this soil runoff is medium, and the erosion hazard is moderate.

Most areas of this soil have been cleared of dense brush and are now in grass. The areas are used for grazing, for water supply, and as habitats for wildlife. Capability unit VIe–8.

Los Gatos gravelly loam, schist bedrock, 50 to 65 percent slopes (LvF).—On this soil drainage is somewhat excessive. Runoff is rapid, and the erosion hazard is very severe.

This soil has a dense cover of brush. It is used for water supply and as habitats for wildlife. If the brush is burned off, the new vegetation provides some browse and forage for livestock and deer for several years before brush reclaims the site. Capability unit VIIe–8.

Los Gatos gravelly loam, 30 to 50 percent slopes (LuE).—This soil overlies slightly metamorphosed sandstone and shale, but it is otherwise similar to Los Gatos gravelly loam, schist bedrock, 30 to 50 percent slopes. The gravel content is 15 to 25 percent in the surface layer and 20 to 35 percent in the subsoil.

This soil has a dense cover of brush. It is used for water supply and for wildlife habitats. If the brush is burned off, the new brush sprouts provide some browse for wildlife and livestock. Capability unit VIIe–8.

Los Gatos gravelly loam, 50 to 65 percent slopes (LuF).—On this soil drainage is somewhat excessive. Runoff is very rapid, and the erosion hazard is very severe.

Most of this soil is under a dense cover of brush, and the areas are used for water supply and for wildlife habitats. If the brush is burned off, the new brush sprouts provide some browse for livestock and wildlife. Capability unit VIIe–8.

Los Gatos-Josephine gravelly loams, 30 to 50 percent slopes (LxE).—About 40 to 60 percent of this complex consists of Los Gatos gravelly loam, 30 to 50 percent slopes, and about 30 to 40 percent is Josephine gravelly loam, 30 to 50 percent slopes.

Included with this unit are small areas of Maymen gravelly loam, schist bedrock, on 30 to 50 percent slopes, and of Sheetiron gravelly loam, shallow, 30 to 50 percent slopes. These included soils make up from 10 to 20 percent of any one area.

Dense stands of brush and knobcone pine grow on these soils. The areas are also used for water supply and for wildlife habitats. Capability unit VIIe–8.

Los Gatos-Parrish gravelly loams, 30 to 50 percent slopes (LyE).—About 40 to 50 percent of this complex is Los Gatos gravelly loam, schist bedrock, 30 to 50 percent slopes, and about 30 to 50 percent is Parrish gravelly loam, 30 to 50 percent slopes.

Included with this unit are small areas of Maymen gravelly loam, schist bedrock, on 30 to 50 percent slopes. This included soil makes up from 10 to 20 percent of any one area.

All areas of this complex are under a dense cover of brush. The areas are used for water supply and for wildlife habitats. If the brush is burned off, the new brush sprouts provide some browse for livestock and wildlife. Capability unit VIIe–8.

Marvin Series

The Marvin series consists of deep, nearly level to gently sloping, fine-textured soils that are moderately well drained or somewhat poorly drained. These soils formed under annual grasses and forbs in mixed alluvium derived from various kinds of rock. They are along the lower edges of old deposits on flood plains of the Sacramento River in the southeastern part of the county. The areas are on both sides of the river at elevations of 60 to 100 feet. The average annual rainfall is about 16 to 19 inches.

The surface layer, a grayish-brown silty clay loam or light silty clay, is slightly acid. The subsoil is dark grayish-brown silty clay that is neutral to mildly alkaline. It grades to brown or light yellowish-brown silty clay loam or light silty clay that is mildly alkaline to moderately alkaline and calcareous. In places Marvin soils are affected by salts and alkali and have an intermittent high water table in summer during the rice-growing season.

These soils are closely associated with the Willows and Zamora soils. They occupy areas between the well-drained Zamora soils, on higher areas of the old flood plain of the Sacramento River, and the poorly drained Willows soils, in basins.

Much of the acreage of the Marvin soils is used for rice and a variety of irrigated field and forage crops. Some areas are dryfarmed to small grain or used for annual range.

Marvin silty clay loam, 0 to 2 percent slopes (MbA).—This soil is on the lower edges of the flood plain that borders areas in basins. It occupies fairly large areas on both sides of the Sacramento River south of Jacinto.

Representative profile:

0 to 13 inches, grayish-brown, hard silty clay loam that is very dark grayish brown and friable to firm when moist; a few, indistinct, yellowish-brown mottles; massive to subangular blocky structure; slightly acid.

13 to 29 inches, dark grayish-brown, very hard silty clay that is very dark grayish brown and firm when moist; weak, prismatic to coarse, blocky structure; slightly acid, but neutral in the lower part; a few very small pellets of iron and manganese.

29 to 42 inches, mottled grayish-brown and dark grayish-brown, very hard silty clay that is very dark grayish brown and firm when moist; a few, faint, yellowish-brown mottles; subangular blocky structure; mildly alkaline and slightly calcareous; lime is segregated in soft masses.

42 to 60 inches +, brown, hard light silty clay that is silty clay loam with increasing depth and dark grayish brown and firm when moist; a few, faint, yellowish-brown mottles; massive; moderately alkaline and strongly calcareous; lime is both finely disseminated and segregated in soft masses.

The surface layer, a light brownish-gray or grayish-brown to gray clay loam or silty clay loam, is slightly acid to neutral. The subsoil is dark grayish-brown to dark-brown silty clay or clay. It is neutral to mildly alkaline and is calcareous in the lower part. The substratum ranges from grayish brown or brown to yellowish brown or olive brown in color. It is clay loam, silty clay loam, light silty clay, or light clay in texture, and it is mildly alkaline to moderately alkaline and slightly calcareous to strongly calcareous. Rust mottles in the soil vary from field to field, depending upon past cropping history. In areas that have been in rice, many, distinct, strong-brown mottles are in the surface layer and a few bluish-green gley spots are in the lower part of the subsoil and in the substratum.

Permeability of this soil is slow. Drainage is moderately good. Runoff is slow to very slow, and erosion is not a hazard. The available moisture holding capacity is 9 to 11 inches, and fertility is moderate. Root penetration is deep. Areas used for rice have an intermittent high water table at a depth of 2½ to 4 feet in summer during the growing season.

Included with this soil are small areas of Marvin silty clay and a few areas of soil affected by excess salts and alkali.

Rice is the most extensive irrigated crop grown on this Marvin soil. Other irrigated field and forage crops are chiefly milo, corn, sudangrass, pasture plants, and alfalfa, but sugarbeets are grown in some places. Almonds and olives are grown in places, but they do not grow well in areas near ricefields, because of the intermittent high water table. Most dryfarmed acreage is east of the Sacramento River and is used chiefly for barley. After the barley is harvested, the stubble is left, volunteer native grasses emerge, and the fields are then used for range. Dryfarmed safflower and milo are grown in some places.

In fall good hunting is provided for sportsmen by pheasant, the main game bird in the areas, and by migratory wildfowl, which feed in the rice and barley stubble. Capability unit IIs–3.

Marvin silty clay loam, 2 to 10 percent slopes (MbB).—This soil is on side slopes of small drainageways. Runoff is slow to medium, and the erosion hazard is slight Drainage is moderately good.

All of this soil generally is dryfarmed to barley or used for annual range. The forage is mainly volunteer barley and annual grasses and forbs. Capability unit IIe–3.

Marvin silty clay loam, slightly saline-alkali, 0 to 1 percent slopes (Mba).—From 5 to 20 percent of the surface

layer of this soil is affected by slight to strong concentrations of salts and alkali. Drainage is somewhat poor.

Large areas of this soil are used for rice and dryfarmed barley. The main other irrigated crops are milo, corn, pasture plants, and sudangrass, but alfalfa and sugarbeets are grown in some areas. Dryfarmed crops are safflower and annual range for grazing. Pheasant and migratory waterfowl are the chief kinds of wildlife. Capability unit IIIw–3.

Marvin silty clay loam, moderately saline-alkali, 0 to 1 percent slopes (Mbb).—From 20 to 50 percent of the surface layer of this soil is affected by slight to strong concentrations of salts and alkali. Drainage is somewhat poor.

This soil is used mainly for rice, irrigated pasture, and dryfarmed barley in rotation with annual pasture. Yields are low because of the large acreage affected by salts and alkali. Pheasant and migratory waterfowl are the main wildlife during the winter. Capability unit IIIw–6.

Marvin silty clay, 0 to 1 percent slopes (Ma).—This soil has a surface layer of light silty clay, but it is otherwise similar to Marvin silty clay loam, 0 to 2 percent slopes. Drainage is somewhat poor.

Much of the acreage of this soil is used for rice. The other chief irrigated crops are pasture plants, milo, and corn. Dryfarmed areas are used for barley, safflower, or annual range. An intermittent high water table occurs during the growing season in areas of this soil in rice. Pheasant and migratory waterfowl, the chief kinds of wildlife, provide good hunting during fall and winter. Capability unit IIIw–5.

Marvin silty clay, slightly saline-alkali, 0 to 1 percent slopes (Maa).—From 5 to 20 percent of the surface area of this soil is affected by slight to strong concentrations of salts and high exchangeable sodium, but this soil is otherwise similar to Marvin silty clay, 0 to 1 percent slopes. Drainage is somewhat poor.

Most of this soil is used for rice and irrigated pasture. A small acreage is used for milo and alfalfa. Dryfarmed areas are used mainly for barley, and the areas are then grazed by sheep and cattle for 1 to 3 years. In fall and winter pheasant and waterfowl provide good hunting for sportsmen. Capability unit IIIw–5.

Marvin silty clay, moderately saline-alkali, 0 to 1 percent slopes (Mab).—From 20 to 50 percent of the surface area of this soil is affected by slight to strong concentrations of excess salts and alkali, but this soil is otherwise similar to Marvin silty clay, 0 to 1 percent slopes. Drainage is somewhat poor.

This soil is well suited to rice or irrigated pasture. Dryfarmed areas are good for annual range and barley. Other areas are used the same as other Marvin soils that are saline-alkali affected. Capability unit IIIw–6.

Marvin silty clay, overflow, 0 to 5 percent slopes (MaoB).—This soil is on side slopes of minor drainageways that carry runoff water during the rainy season. It is subject to flooding for short periods at least once or twice a year but is otherwise similar to Marvin silty clay, 0 to 1 percent slopes. Drainage is somewhat poor.

This soil is well suited to dryfarmed small grain grown in rotation with pasture for sheep and cattle. Capability unit IVw–1.

Masterson Series

The Masterson series consists of rolling to hilly, moderately deep or deep soils that are well drained. These soils formed in material from schistose metasedimentary rock. They are on ridgetops and steep mountain slopes, generally in the northwestern part of the county, at elevations of more than 5,500 feet. The vegetation is mainly forests of coniferous trees, but in places hardwoods and low shrubs grow. Average annual precipitation is 50 to 65 inches.

The surface layer, a brown or dark-brown gravelly loam, is medium acid to strongly acid. Below is brown to light yellowish-brown gravelly or very gravelly loam that is strongly acid to very strongly acid. The gravel generally increases in size and amount with increasing depth. These soils are friable throughout. Depth to weathered parent rock ranges from 20 to more than 50 inches. Rocks crop out in only a few places.

In many places Masterson soils are associated with the Sheetiron soils, which are from similar kinds of parent material and are at elevations of less than 6,000 feet. They are also associated with soils of the Neuns series, which formed in material from metavolcanic rock and are near Black Butte.

Masterson soils are used for production of timber and Christmas trees, to which they are well suited. The brush in the understory provides protection and browse for wildlife.

Masterson gravelly loam, 10 to 30 percent slopes (McD).—This moderately deep and deep soil is under timber on broad ridgetops in the northwest corner of the county.

Representative profile:

2 inches to 0, fresh, partly decomposed litter consisting of conifer needles and twigs.
0 to 7 inches, brown to dark-brown, soft gravelly loam that is dark brown or very dark brown and very friable when moist; the gravel consists of platy schistose and angular quartzite fragments that generally are less than one-half inch in size; medium, granular structure; strongly acid.
7 to 21 inches, brown, soft gravelly loam that is dark brown and very friable when moist; medium, granular structure; very strongly acid.
21 to 35 inches, light yellowish-brown, soft very gravelly loam that is yellowish brown and very friable when moist; medium and coarse, granular structure; very strongly acid.
35 inches +, fractured and partly weathered sericite schist that is strongly folded and tilted and has seams of white quartzite; in places soil material and roots are in the cracks between the rocks.

The surface layer generally is brown or dark brown but in places is grayish brown. The upper part of the subsoil is brown or light reddish brown, and the lower part is light yellowish brown or light brownish yellow. Both layers consist of gravelly or very gravelly loam. Throughout the profile, the soil material feels like talc. The gravel generally increases in size and amount with increasing depth and makes up from 40 to 65 percent of the soil mass, by volume. Rocks crop out in only a few places. The soil is medium acid to strongly acid in the surface layer and very strongly acid in the subsoil. Depth to the weathered parent rock ranges from 20 to more than 50 inches, but it generally is 30 to 42 inches.

Permeability of this soil is moderate to moderately rapid. Runoff is medium, and the erosion hazard is mod-

erate. Root penetration is moderately deep to deep, and roots extend into the parent rock along cracks. The available water holding capacity is 3 to 5 inches.

Most areas of this soil are at elevations of more than 6,000 feet, and dense to semidense stands of red and white firs grow on them. In some areas mountain whitethorn and wild cherry are scattered throughout the understory.

This soil is well suited to trees, and tree growth is moderate to moderately rapid. The trees that grow on this soil, however, are less desirable for timber than those that grow on forest soils at lower elevations. Many areas of this soil are in young regrowth, and these are well suited to the growing of high-quality Christmas trees. The understory of brush in the forests provides browse for wildlife and also protects the watershed. This soil is also used for recreational purposes, mainly camping and deer hunting. Capability unit IVe–4.

Masterson gravelly loam, 30 to 50 percent slopes (McE).—This soil is on steep side slopes of mountains. Runoff is medium to rapid, and the erosion hazard is moderate to severe.

Most areas of this soil are at elevations of more than 6,000 feet, and semidense to dense stands of white and red firs cover the areas. A few areas are at elevations of less than 6,000 feet, and on these the stands contain Douglas-fir, ponderosa pine, and sugar pine, as well as white and red firs.

Included with this soil at the lower elevations are small areas of Sheetiron soils.

This Masterson soil is suited to trees. Capability unit VIe–4.

Masterson gravelly loam, moderately deep, 10 to 30 percent slopes (MdD).—In this soil depth to weathered parent rock generally is less than 30 inches. In some places 25 to 50 percent of the surface soil has been lost through erosion. The available moisture holding capacity is 2 to 4 inches. Runoff is medium, and the erosion hazard is moderate.

This soil is well suited to the growing of Christmas trees. Capability unit IVe–4.

Masterson gravelly loam, moderately deep, 30 to 50 percent slopes (MdE).—This soil generally is less than 30 inches deep to bedrock. In some areas as much as 50 percent of the surface soil has been removed through erosion.

Most of this soil is used for the production of timber. A few areas consist of young regrowth, and these are well suited to the growing of Christmas trees. In most areas the understory consists of mountain whitethorn, pinemat manzanita, and wild cherry, which provide protection and browse for wildlife. Capability unit VIe–4.

Maymen Series

The Maymen series consists of rolling to steep, gravelly soils that are somewhat excessively drained or excessively drained. These soils are very shallow or shallow over sericite schist or weakly metamorphosed sandstone and shale. They are in mountainous areas at elevations of 1,500 to 5,000 feet. The native vegetation is shrubs, and chamise, ceanothus, manzanita, chaparral oaks, and mountain mahogany are dominant in the stands. In the understory grasses are sparse and are mainly fescues and other annuals. The average annual precipitation is 25 to 45 inches.

These soils consist of pale-brown to light yellowish-brown gravelly loam. They are medium acid to strongly acid throughout. Depth to sericite schist or slightly metamorphosed sandstone and shale is typically 6 to 15 inches.

Maymen soils are associated mainly with soils of the Josephine, Los Gatos, Parrish, and Sheetiron series.

Most areas of the Maymen soils are used for water supply and wildlife purposes. Some gently sloping areas have been cleared of brush and converted to grass, and these provide forage for livestock and deer.

Maymen gravelly loam, schist bedrock, 30 to 65 percent slopes (MdmE).—This soil is very shallow and is on mountain slopes.

Representative profile:

0 to 9 inches, pale-brown to light yellowish-brown, slightly hard gravelly loam that is dark grayish brown to dark brown and friable when moist; weak, subangular blocky structure; medium acid.

9 inches +, yellowish-brown, folded and fractured sericite schist that has many seams and lenses of quartzite.

In color the surface layer ranges from pale brown or brown to grayish brown, and the subsoil from light yellowish brown to pale brown. The texture is gravelly sandy loam or loam. The content of gravel ranges from 40 to 65 percent, and the gravel increases in size and amount with increasing depth. Depth to bedrock is 5 to 12 inches. Most of the surface soil has been removed through erosion.

This soil is excessively drained. Permeability is moderately rapid, runoff is very rapid, and the erosion hazard is very severe. The available water holding capacity is 1 to 2 inches. Root penetration generally is very shallow to shallow, but in places roots penetrate into cracks in the parent material. Fertility is low.

Included with this soil are small areas of Los Gatos and Parrish gravelly loams. These included soils make up from 10 to 25 percent of each area.

This Maymen soil is used for water supply and wildlife areas. Deer are the principal wildlife. Areas that are burned over provide browse for livestock and wildlife in places. Capability unit VIIIs–8.

Maymen gravelly loam, shallow over schist, 30 to 65 percent slopes (MdkE).—In this soil depth to bedrock is 12 to 20 inches. The available water holding capacity is 1 to 3 inches.

This soil is used for water supply and wildlife areas. Use is otherwise the same as for Maymen gravelly loam, schist bedrock, 30 to 65 percent slopes. Capability unit VIIIs–8.

Maymen gravelly loam, 10 to 30 percent slopes (MdgD).—This soil is on rolling to hilly ridgetops, but it is otherwise similar to Maymen gravelly loam, schist bedrock, 30 to 65 percent slopes. Drainage is somewhat excessive. Runoff is medium to rapid, and the erosion hazard is moderate to severe.

This soil is used for summer range and as water supply and wildlife areas. In places the brush has been removed and the areas planted to hardinggrass, intermediate wheat, tall fescue, blando brome, annual or perennial ryegrasses, milo, and similar grasses. The grasses provide forage for livestock and wildlife and increase the water supply. Areas in grasses also are more accessible

to hunters. They are less susceptible to fire than areas in brush, and if fire starts, it is easier to control. Capability unit VIIs–8.

Maymen gravelly loam, 30 to 65 percent slopes (MdgE).—This soil overlies slightly metamorphosed sandstone and shale and is 30 to 45 percent gravel. The areas are used for water supply and wildlife purposes. Use is otherwise the same as for Maymen gravelly loam, schist bedrock, 30 to 65 percent slopes. Capability unit VIIIs–8.

Maymen-Los Gatos gravelly loams, 30 to 65 percent slopes (MdoE).—From 40 to 50 percent of this mapping unit is Maymen gravelly loam, schist bedrock, 30 to 65 percent slopes, or is Maymen gravelly loam, 30 to 65 percent slopes. Of the rest, from 30 to 40 percent is Los Gatos gravelly loam, schist bedrock, 30 to 50 percent slopes; Los Gatos gravelly loam, 30 to 50 percent slopes; or Los Gatos gravelly loam, 50 to 65 percent slopes.

Included with this unit are small areas of Parrish gravelly loam, 30 to 50 percent slopes, and of Maymen-Los Gatos gravelly loams, 10 to 30 percent slopes. These included soils make up 10 to 20 percent of each area.

All of these soils are used as water supply areas and for wildlife habitats. Removing the brush and planting to grass are limited mainly to the included soils on slopes of 10 to 30 percent. Capability unit VIIs–8.

Maymen-Los Gatos gravelly loams, 10 to 30 percent slopes (MdoD).—The soils in this mapping unit are on rolling to hilly ridgetops or benches, but they are otherwise similar to those in Maymen-Los Gatos gravelly loams, 30 to 65 percent slopes.

Included with this unit are small areas of Parrish gravelly loam, 10 to 30 percent slopes. This included soil makes up from 10 to 20 percent of each area.

Most of the brush on these soils has been removed. The areas are used mainly for pasture, range, water supply, and wildlife. Capability unit VIIs–8.

Maymen-Parrish gravelly loams, 30 to 65 percent slopes (MdpE).—From 40 to 50 percent of this mapping unit is Maymen gravelly loam, schist bedrock, 30 to 65 percent slopes, or is Maymen gravelly loam, 30 to 65 percent slopes. The rest is 30 to 40 percent Parrish gravelly loam, 30 to 50 percent slopes; Parrish gravelly loam, shallow, 30 to 50 percent slopes; or Parrish gravelly loam, shallow, 50 to 65 percent slopes.

Included with this unit are small areas of Los Gatos gravelly loam on slopes of 30 to 50 and 50 to 65 percent. These included soils make up from 10 to 20 percent of each area.

All of these soils are used for water supply and as wildlife areas. The vegetation is mainly semidense to dense stands of brush. Capability unit VIIs–8.

Maymen-Parrish gravelly loams, 10 to 30 percent slopes (MdpD).—The soils in this mapping unit are on rolling to hilly ridgetops, but they are otherwise similar to those in Maymen-Parrish gravelly loams, 30 to 65 percent slopes.

Included with this unit are small areas of Los Gatos gravelly loam, schist bedrock, 10 to 30 percent slopes. This included soil makes up from 10 to 20 percent of each area.

Most of the brush on all of these soils has been removed and the areas seeded to pasture. The areas are used chiefly for water supply and to provide forage for livestock and wildlife. Capability unit VIIs–8.

Maywood Series

In the Maywood series are shallow to moderately deep, nearly level soils that are well drained to somewhat excessively drained. These soils formed in recent alluvium from softly consolidated sediments of the Tehama formation. They are under grasses and trees on benches adjacent to intermittent creeks at elevations of 150 to 400 feet. The areas are chiefly along Hambright Creek, west of Orland, and along Walker Creek, northwest of Artois. The average annual rainfall is 16 to 18 inches.

Maywood soils are pale brown, medium textured, and slightly acid to neutral. They are somewhat stratified. Depth to river sand and gravel is 15 to 40 inches.

These soils are associated mainly with soils of the Arbuckle, Cortina, and Tehama series.

Areas of the Maywood soils are too small to manage separately and are used the same as adjacent soils. Among the crops grown are irrigated tree and forage crops and dryfarmed grain.

Maywood loam, shallow over gravel (Me).—This is the only Maywood soil mapped in the county. It is on narrow benches slightly above the channels of Hambright and Walker Creeks. Slopes range from 0 to 2 percent.

Representative profile:

0 to 26 inches, pale-brown, slightly hard loam that is brown and friable when moist; stratified thin layers of fine sandy loam, silt loam, and gravelly fine sandy loam at a depth below 14 inches; massive; slightly acid throughout.
26 to 60 inches +, multicolored river sand and gravel; the gravel is mainly quartzite and chert.

Depth to sand and gravel ranges from 15 to 40 inches but generally is 20 to 30 inches. The soil is pale brown to light yellowish brown throughout. It is dominantly loam in texture, but it ranges from fine sandy loam to silt loam and in small areas is slightly gravelly. The lower part of the soil profile typically is stratified, and stratification is quite variable. In places lenses of mottled silt loam occur just above the stratified, coarse-textured material.

The water table is at a depth of 3 to 5 feet during the rainy season or when irrigation water is diverted into the creeks. In some places the soil is flooded when the creeks are running full. Permeability is moderate in the upper part and rapid to very rapid in the underlying sand and gravel. Runoff is slow, and the erosion hazard is slight. Fertility is medium to high. The available water holding capacity is 3 to 6 inches.

Included with this soil are small areas of gravelly Cortina soils and of Riverwash.

Because areas of this Maywood soil are too small to manage separately, they are farmed the same as adjoining soils.

Areas along Hambright Creek are used mainly for pasture. Some areas that are parallel to areas of Orland or Wyo soils are used for alfalfa, corn, irrigated pasture, or for such tree crops as almonds, olives, and oranges. Areas along Walker Creek generally are used for annual range or dryfarmed barley. Capability unit IVs–4.

Millsap Series

In the Millsap series are hilly to very steep, shallow to moderately deep, well-drained soils that have a claypan. These soils formed in material from fine-grained sandstone and shale of the Knoxville formation and of other formations of the Lower Cretaceous period. They occupy a narrow area along the western edge of the foothills that extends northward from the Colusa County line to the Tehama County line west of Newville. Elevations range from 500 to 2,000 feet. The vegetation is predominantly annual grasses and blue oaks, but a few shrubs and Digger pines grow on some areas. Average annual rainfall is 20 to 30 inches.

The surface layer, a pale-brown or brown heavy loam or clay loam, is slightly acid. It abruptly overlies brown or dark-brown clay or shaly clay that is slightly acid or medium acid. Depth to the underlying rock ranges from 15 to 30 inches, but it generally is less than 20 inches. These rocks are dark gray to olive gray and are steeply tilted and somewhat folded in places. Rocks crop out in a few places.

These soils generally are associated with the very shallow Lodo soils and in many places are mapped in complexes with them. They also are associated with the shallow Millsholm soils, formed in material from conglomerates, and with the gravelly Corning, Newville, and Perkins soils, which in many places cap the Millsap soils on terraces.

Millsap soils are used mainly for grazing sheep and cattle. The quality of the forage is fair, but the quantity is limited because of the low water-holding capacity of the soils and the overstory of blue oaks and shrubs. A few areas on gentle slopes are dryfarmed to hay or grain occasionally.

Millsap loam, 30 to 50 percent slopes (MfE).—This shallow soil occupies a few areas along the western edge of the foothills between the Colusa County line and Newville. It generally is associated with the Lodo, Millsholm, and Newville soils.

Representative profile:

0 to 6 inches, pale-brown, hard heavy loam that is brown and friable when moist; a few shale fragments; moderate, medium to coarse, subangular blocky structure; slightly acid.
6 to 17 inches, brown, very hard shaly clay that is dark brown and firm when moist; strong, very coarse, angular blocky structure; slightly acid to medium acid.
17 inches +, very hard, highly fractured and slightly weathered, dark-gray shale; a few roots of trees and shrubs penetrate the bedrock along fracture lines.

In color the surface layer ranges from pale brown to brown or light yellowish brown, and the subsoil from brown or dark brown to strong brown.

The surface layer is heavy loam or light clay loam and contains a few fragments of shale. The subsoil is slightly shaly or shaly clay. Coarse fragments generally increase in size and amount with increasing depth. Depth ranges from 15 to 30 inches but is predominantly 17 to 20 inches. The parent rock is shale or fine-grained sandstone. The soil is slightly acid or medium acid throughout. In some areas a thin surface layer that has weak, platy structure is present.

Permeability is slow. Runoff is rapid, and the erosion hazard is high. The water-holding capacity is 2 to 3 inches. Fertility is low.

This soil is too steep for cultivation. All of the acreage is in range. Capability unit VIe–3.

Millsap loam, 50 to 65 percent slopes (MfF).—On this soil runoff is rapid to very rapid, and the erosion hazard is very severe.

This soil is all used for range. Capability unit VIIe–3.

Millsholm Series

The Millsholm series consists of shallow, well-drained to somewhat excessively drained, rolling to very steep soils. These soils are in the foothills and in the mountainous uplands. They formed in material from sandstone and shale, from conglomerate, and from metamorphosed sedimentary rock. The vegetation is mostly annual grasses and forbs or consists of trees, grasses, and some shrubs. Blue oaks and Digger pines are the main trees, and fescues, bromes, wild oats, and forbs are the main annual grasses. Shrubs are mainly common manzanita and buckbrush, but in a few areas chamise grows in dense stands.

Precipitation ranges from 18 to 25 inches in the foothills, and from 25 to 40 inches in the mountains. Elevations range from 200 to 2,000 feet in the foothills, and from 1,200 to 4,000 feet in the mountains. In the foothills these soils are associated mainly with the Sehorn and Contra Costa soils, but in the mountains they are associated chiefly with the Parrish and Polebar soils.

Millsholm soils have a surface layer and subsoil of brown clay loam or gravelly sandy loam or pale-brown gravelly loam. Depth to bedrock typically is 14 to 20 inches, but it ranges from 8 to 26 inches. These soils are slightly acid to medium acid but are slightly less acid with increasing depth. Rocks crop out on the gravelly sandy loams.

Most areas of the Millsholm soils are used for annual range, wildlife, and water supply. Some areas are used for dryfarmed small grain.

Millsholm clay loam, 10 to 30 percent slopes (MhD).—This soil is in the foothills. It is shallow over unaltered sandstone and shale.

Representative profile:

0 to 16 inches, pale-brown or brown, hard clay loam that is dark brown and friable when moist; structure is weak, platy in the uppermost 1 inch and subangular blocky below; slightly acid, but very slightly acid to neutral with increasing depth; a few shale fragments in the lower part.
16 inches +, brown and grayish-brown fractured shale and fine-grained sandstone; noncalcareous.

In color this soil is pale brown, brown, or light yellowish brown. The texture ranges from clay loam to silty clay loam. Reaction is slightly acid to neutral. Depth to parent rock ranges from 10 to 24 inches, but it is predominantly 14 to 20 inches.

This soil is well drained. Permeability is moderate, runoff is medium, and the erosion hazard is moderate. The available water holding capacity is 2 to 3 inches. Root depth is shallow, and fertility is low.

Included with this soil are small areas of Sehorn clay and clay loam. Also included are small areas of Altamont clay.

Millsholm clay loam, 10 to 30 percent slopes, is used mainly for annual range, but some areas are in dryfarmed grain. Capability unit IVe–5.

Millsholm clay loam, 30 to 50 percent slopes (MnE) On this soil runoff is rapid, and the erosion hazard is severe. This soil is used for annual range, wildlife, and water supply. Capability unit VIe–5.

Millsholm clay loam, 30 to 65 percent slopes, eroded (MnE2).—This soil is on south-facing slopes that are moderately eroded. It typically is 6 to 12 inches deep over bedrock and in some places has rock fragments on the surface. A few areas are cut by gullies 2 to 3 feet deep. Runoff is rapid to very rapid, and the erosion hazard is severe to very severe.

This soil is used for annual range, wildlife, and water supply. Capability unit VIIs–8.

Millsholm rocky loam, 10 to 30 percent slopes (MlD).—This soil is loam throughout, but it otherwise is similar to Millsholm clay loam, 10 to 30 percent slopes. Also the available water holding capacity is slightly less, and rock outcrops occupy 2 to 10 percent of the surface.

This soil is used for annual range, wildlife, and water supply. Capability unit VIs–8.

Millsholm rocky loam, 30 to 50 percent slopes (MlE).—On this soil runoff is rapid, and the erosion hazard is severe. This soil is used for annual range, wildlife, and water supply. Capability unit VIIs–8.

Millsholm rocky clay loam, 10 to 30 percent slopes (MoD).—On this soil outcrops of sandstone or shale rock occupy 2 to 10 percent of the surface.

This soil is too rocky and droughty for cultivation and is therefore used for annual range, wildlife, and water supply. Capability unit VIs–8.

Millsholm rocky clay loam, 30 to 65 percent slopes (MoE).—The erosion hazard on this soil is severe to very severe. This soil is used for annual range, wildlife, and water supply. It is too steep and rocky for tillage. Capability unit VIIs–8.

Millsholm very rocky loam, 15 to 45 percent slopes (MtD).—This soil is loam throughout the profile, and the available water holding capacity is slightly less than for Millsholm clay loam, 10 to 30 percent slopes. Rock outcrops occupy 10 to 25 percent of the surface. Slopes are dominantly 15 to 30 percent. Runoff is medium to rapid, and the erosion hazard is moderate to severe.

This soil is used for annual range, wildlife, and water supply. Capability unit VIs–8.

Millsholm very rocky sandy loam, 30 to 65 percent slopes (MuE).—This soil is underlain by conglomerate and is very gravelly. It is along the western edge of the foothills on prominent hogback ridges. Rock outcrops occupy 10 to 25 percent of the surface.

Representative profile:

0 to 23 inches, brown, slightly hard very gravelly sandy loam that is dark brown and friable when moist; massive; medium acid to slightly acid.
23 inches +, hard, massive conglomerate.

This soil is light-brown to brown gravelly or very gravelly sandy loam or light loam. Gravel makes up 40 to 60 percent of the soil mass. Depth to conglomerate ranges from 14 to 26 inches. Reaction is medium acid to slightly acid. The rock outcrops are large and massive.

On this soil drainage is somewhat excessive. Permeability is moderate, runoff is rapid, and the erosion hazard is severe. The available water holding capacity is 2 to 3 inches. Fertility is low.

Included with this soil are a few areas of Millsholm loam and clay loam and of Contra Costa clay loam.

This Millsholm soil is used for annual range, wildlife, and water supply. It is too steep and rocky for cultivation. Capability unit VIIs–8.

Millsholm rocky sandy loam, 10 to 30 percent slopes (MrD).—This soil has 2 to 10 percent of rock outcrops on the surface. Drainage is good, runoff is medium, and the erosion hazard is moderate.

This soil is too rocky and droughty to cultivate. It is used for annual range, wildlife, and water supply. Capability unit VIs–8.

Millsholm rocky sandy loam, 30 to 50 percent slopes (MrE).—This soil has 2 to 10 percent of rock outcrops on the surface. It is used for annual range, wildlife, and water supply. Capability unit VIIs–8.

Millsholm rocky sandy loam, 30 to 50 percent slopes, eroded (MrE2).—This soil has 2 to 10 percent of rock outcrops on the surface, is moderately eroded, and has lower available water holding capacity than Millsholm very rocky sandy loam, 30 to 65 percent slopes. Some areas have a fairly dense growth of chamise on them. Other areas are under annual grasses and a few blue oaks and Digger pines.

All areas of this soil are used for annual range, wildlife, and water supply. Capability unit VIIs–8.

Millsholm gravelly loam, schist bedrock, 50 to 65 percent slopes (MkF).—This soil is in the mountainous uplands of the county. It is underlain by sericite schist or partly metamorphosed sandstone and shale.

Representative profile:

0 to 8 inches, pale-brown, slightly hard gravelly loam that is dark brown and friable when moist; massive to weak, subangular blocky structure; slightly acid to medium acid.
8 to 17 inches, light yellowish-brown, slightly hard very gravelly loam that is dark yellowish brown and friable when moist; massive to weak, subangular blocky structure; medium acid.
17 inches +, folded and fractured, light-colored sericite schist; contains numerous white quartzite seams.

The surface layer is pale brown to light brownish gray and grayish brown, and the subsoil is light yellowish brown to pale brown. Depth to bedrock is dominantly 15 to 20 inches. The surface soil is 25 to 45 percent gravel, and the subsoil is 40 to 65 percent gravel. Reaction is slightly acid to medium and is more acid with increasing depth.

This soil is somewhat excessively drained. Permeability is moderate, runoff is very rapid, and the erosion hazard is very severe. The available water holding capacity is 2 to 3 inches. Root penetration is shallow, and fertility is low.

Included with this soil are small areas of Parrish gravelly loam and of Los Gatos gravelly loam.

This Millsholm soil is used for annual range, wildlife, and water supply. Capability unit VIIe–8.

Millsholm gravelly loam, schist bedrock, 30 to 50 percent slopes (MkE).—On this soil runoff is rapid, and the erosion hazard is severe. This soil is used for annual range, wildlife, and water supply. Capability unit VIe–41.

Millsholm cherty loam, 50 to 65 percent slopes (MgF).—This soil is 20 to 45 percent chert gravel throughout the profile. The parent rock is chert interbedded with slightly metamorphosed sandstone and shale.

This soil is used for annual range, wildlife, and water supply. Capability unit VIIe–8.

Millsholm gravelly loam, 30 to 50 percent slopes (MhE).—This soil is 15 to 35 percent gravel throughout the profile. The parent rock is partly metamorphosed sandstone and shale. Runoff is rapid, and the erosion hazard is severe.

This soil is used for annual range, wildlife, and water supply. Capability unit VIe–41.

Millsholm gravelly loam, 50 to 65 percent slopes (MhF).—This soil is 15 to 35 percent gravel throughout the profile. The parent rock is partly metamorphosed sandstone and shale. In a few places rocks crop out.

This soil is used for range, wildlife, and water supply. Capability unit VIIe–8.

Millsholm soils, 30 to 50 percent slopes (MvE).—This mapping unit consists of about equal acreages of Millsholm clay loam, 30 to 50 percent slopes, and Millsholm rocky sandy loam, 30 to 50 percent slopes. These soils are underlain by sandstone, shale, and conglomerate that are closely interbedded. They are used for annual range, wildlife, and water supply. Capability unit VIIs–8.

Millsholm-Contra Costa clay loams, 30 to 50 percent slopes, eroded (MwE2).—From 50 to 60 percent of this complex is Millsholm clay loam on 30 to 50 percent slopes, eroded, and 40 to 50 percent is Contra Costa clay loam on 30 to 50 percent slopes, eroded. The Millsholm soil is on slopes that face south, and the Contra Costa soil is on toe slopes and slopes that face north. The vegetation is a dense cover of chamise. In some places slopes are as much as 65 percent. Runoff is rapid, and the erosion hazard is severe.

These soils are used for annual range, wildlife, and water supply. In places after a fire, brush sprouts provide browse for livestock and wildlife. Capability unit VIe–5.

Millsholm-Contra Costa complex, 30 to 50 percent slopes (MxE).—From 50 to 60 percent of this complex is Millsholm rocky sandy loam, 30 to 50 percent slopes, and 40 to 50 percent is Contra Costa clay loam on 30 to 50 percent slopes. These soils are underlain by sandstone, shale, and conglomerate that are closely interbedded.

These soils are used for range, wildlife, and water supply. Capability unit VIIs–8.

Millsholm-Lodo complex, 30 to 50 percent slopes, eroded (MyE2).—From 50 to 70 percent of this complex is Millsholm rocky sandy loam, 30 to 50 percent slopes, eroded, and 30 to 50 percent is Lodo shaly clay loam, 30 to 50 percent slopes, eroded. These soils are on prominent hogback ridges and are underlain by stratified conglomerate and shale that are closely interbedded. They are used for annual range, wildlife, and water supply. Capability unit VIIs–8.

Millsholm rocky loam-Gullied land complex, 15 to 30 percent slopes (MmD).—This complex consists of Millsholm rocky loam that is cut by gullies but otherwise is similar to Millsholm rocky loam, 10 to 30 percent slopes. The gullies are 2 to 3 feet deep and are at intervals of 500 to 1,000 feet.

All areas of this complex are used for annual range, wildlife, and water supply. Capability unit VIs–8.

Millsholm rocky loam-Gullied land complex, 30 to 65 percent slopes (MmE).—This complex consists of Millsholm rocky loam that is cut by gullies and is steeper but otherwise is similar to Millsholm rocky loam, 10 to 30 percent slopes. The gullies are 2 to 3 feet deep and are at intervals of 500 to 1,000 feet. Runoff is rapid to very rapid, and the erosion hazard is severe to very severe.

All areas of this complex are used for annual range, wildlife, and water supply. Capability unit VIIs–8.

Millsholm clay loam-Gullied land complex, 10 to 30 percent slopes (MngD).—This complex consists of Millsholm clay loam, 10 to 30 percent slopes, that is cut by gullies. The gullies are 2 to 3 feet deep and are at intervals of 500 to 1,000 feet.

Most areas of this complex are used for annual range, wildlife, and water supply. Some areas are used for dry-farmed grain. Capability unit IVe–5.

Millsholm rocky clay loam-Gullied land complex, 15 to 50 percent slopes (MpE).—This complex consists of Millsholm rocky clay loam that is less steep and is cut by gullies but otherwise is similar to Millsholm rocky clay loam, 30 to 65 percent slopes, eroded. The gullies are 2 to 3 feet deep and are at intervals of 500 to 1,000 feet. Slopes are dominantly steep.

All of this complex is used for annual range, wildlife, and water supply. Slopes are too steep and rocky for cultivation. Capability unit VIIs–8.

Millsholm-Gullied land complex, 30 to 50 percent slopes (MsE).—This unit consists of Millsholm clay loam, 30 to 50 percent slopes, that is cut by gullies 2 to 3 feet deep at intervals of 500 to 1,000 feet.

All of this complex is used for annual range, wildlife, and water supply. Slopes are too steep for cultivation, and the gullies keep livestock from grazing the range effectively. Capability unit VIe–5.

Mixed Alluvial Land

Mixed alluvial land (0 to 15 percent slopes) (Mdw) consists of partly wet and wet meadows in mountainous areas in the western part of the county. They are mostly at elevations of more than 6,000 feet, but one wet meadow is adjacent to Lee Logan Camp at an elevation of 4,200 feet. The average annual precipitation is 50 to 65 inches. The areas generally are near soils of the Masterson, Neuns, and Sheetiron series, which are under timber.

All areas of Mixed alluvial land are fed by springs that are at the upper edges of the areas or are within the meadow area. Drainage is very poor around the springs and along the swale drainageways but is better with increasing distance from these waterlogged areas.

The soil material in this unit is quite variable, depending upon its location within the meadow. Slopes generally are moderately steep to steep. In the waterlogged areas, the soil material in the upper part generally is dark-gray or very dark gray, very friable gravelly loam that is medium acid to slightly acid. This material is about 15 to 30 inches thick and overlies gray to light-gray gravelly clay loam that is medium acid to slightly acid. Prominent, strong-brown mottles are in the uppermost part of the overlying material and bluish-green mottles are in the lower part. Bluish-green mottling increases in amount in the wet underlying material. At the outer fringes of the meadow, the soil material contains less organic matter and is somewhat poorly drained. Here the upper part of the material generally is grayish-brown or gray gravelly loam and the underlying

material is light-gray or light brownish-gray gravelly loam or clay loam. Mottles are fewer and less distinct and are in the underlying material. Except for the edges of a few areas that border the stony Neuns soils, most areas are free of rock outcrops.

The vegetation on Mixed alluvial land is mostly grasses and forbs, but mountain alders grow in places around springs or along wet drainageways. In waterlogged areas the grasses are mainly sedges and rushes, but corn lily grows in some places. On the better drained side slopes, the vegetation is a mixture chiefly of annual grasses and forbs and a few perennial grasses.

Areas of Mixed alluvial land are popular for summer camping sites, and improved camping and picnicking facilities are available on some areas. They are also used for summer range and provide forage and water for livestock and wildlife. Capability unit Vw–2.

Moda Series

The Moda series consists of moderately deep, nearly level to very gently undulating soils that are well drained. These soils have a hardpan that is cemented with iron and silica. They formed in old, medium-textured alluvium washed mainly from sedimentary and metasedimentary rocks. They are under annual grasses and forbs on old alluvial fans or low terraces at elevations of 175 to 300 feet. The average annual rainfall is 16 to 20 inches.

The surface layer, a brown loam that is medium acid, generally is 12 to 20 inches thick. It abruptly overlies dense, brown or reddish-brown clay that also is medium acid. This horizon is 2 to 10 inches thick and is abruptly underlain by a hardpan that is cemented with iron and silica and is 2 to 15 inches thick. Below is light yellowish-brown, medium textured or moderately fine textured material that is neutral to mildly alkaline.

Moda soils are associated with soils of the Kimball series. They are used for irrigated, shallow-rooted field and forage crops and for dryfarmed small grain.

Moda loam (0 to 3 percent slopes) (Mz).—This is the only Moda soil mapped in the county. It is nearly level to very gently undulating and is on low terraces near areas of Kimball loams, mostly in the northeastern part of the county.

Representative profile:

0 to 14 inches, brown, hard loam that is dark brown and friable when moist; a few small quartzite pebbles; weak, platy structure in the uppermost 1 inch, but massive below; medium acid.

14 to 21 inches, brown to reddish-brown, very hard clay that is dark brown to reddish brown and very firm when moist; medium prismatic structure that is angular blocky with increasing depth; medium acid.

21 to 30 inches, brown and light yellowish-brown material that is cemented with silica and iron; the uppermost 2 inches is a very strongly cemented hardpan, but cementation decreases with increasing depth; slightly acid, but neutral with increasing depth.

30 to 54 inches +, light yellowish-brown hard sandy clay loam that is dark yellowish brown and friable when moist; neutral to mildly alkaline and intermittently calcareous.

The surface layer is light-brown, brown, or reddish-yellow heavy fine sandy loam or loam that in many places contains some gravel. Its color is slightly redder with increasing depth. Reaction is slightly acid to medium acid. Below the surface layer is a brown, reddish-brown, or yellowish-red claypan. The claypan ranges from 2 to 10 inches in thickness and is medium acid to slightly acid.

The substratum is cemented and generally is mottled brown, light yellowish-brown, and brown. It varies greatly in thickness and in hardness. The uppermost 1 to 3 inches is very strongly cemented and has dark-colored, manganese stainings. Cementation decreases with increasing depth. The lower part of the substratum is light yellowish-brown or yellowish-brown, medium-textured to moderately fine textured material that is somewhat stratified. This material is neutral to mildly alkaline and is intermittently calcareous.

Permeability of this soil is very slow. Runoff is slow, and erosion is very slight or is not a hazard. Root penetration is shallow. The available water holding capacity is 3 to 4 inches. Fertility is low.

Included with this soil are small gravelly areas and small areas of Kimball loams.

Moda loam is used for shallow-rooted field and forage crops, mainly milo, corn, ladino clover, and irrigated pasture. In places the areas are used for dryfarmed small grain. Capability unit IIIs–3.

Montara Series

The Montara series consists of moderately steep to steep, fine-textured soils that are well drained and are low in fertility. These soils formed in material from serpentine rock. They are in the upland at elevations of 1,200 to 2,000 feet. The vegetation is chiefly annual grasses and forbs, but shrubs and Digger pines grow in some places. The average annual rainfall is 20 to 35 inches.

These soils are shallow and somewhat rocky. They are dark colored, moderately fine textured or fine textured, and neutral to mildly alkaline. The surface layer is granular, and the subsoil is blocky. Gravel is common throughout the profile.

Montara soils generally are associated with the Henneke soils, which formed under brush from similar material. They are also associated with the shallow Maymen soils, from schistose rock, and the very shallow Lodo soils, from shale.

Much of the acreage of the Montara soils is used for grazing. Some areas provide food and cover for wildlife, but use for water supply is limited.

Montara clay, 20 to 50 percent slopes (MznE).—This is the only Montara soil mapped in the county. It is along the western edge of the foothills south of Elk Creek, at the contact between soils on rock of the Knoxville formation and those on rock of the Franciscan formation.

Representative profile:

0 to 2 inches, dark grayish-brown, hard clay that is very dark grayish brown and friable when moist; granular structure; neutral; contains many small pieces of serpentine gravel.

2 to 23 inches, olive-gray, very hard clay that contains a few pebbles; dark olive gray and very firm when moist; the pebbles are small pieces of serpentine and increase in amount with increasing depth; coarse subangular blocky structure in the upper part but angular blocky in the lower part; mildly alkaline.

23 inches +, hard, fractured, greenish-gray serpentine rock.

The color is dark grayish brown, dark gray, or olive gray and changes little throughout the profile. Texture ranges from slightly gravelly or gravelly clay loam to clay. Gravel makes up 10 to 35 percent of the soil mass, by volume, and increases in size and amount with increasing depth. The surface layer is neutral to mildly alkaline, and the subsoil is mildly alkaline to moderately alkaline. Rock outcrops are common, and they occupy 2 to 10 percent of the surface area in some places. Depth ranges from 5 to 25 inches but is dominantly 12 to 24 inches. Included with this unit are small areas of Henneke stony clay loam.

Except for a few seep areas where rocks of different formations come together, drainage is good. Permeability is slow. Runoff is medium to rapid, and the erosion hazard is moderate to severe. The available water holding capacity is 3 to 4 inches. Root penetration is shallow.

Included with this soil are small areas of Henneke stony clay loam.

This Montara soil provides limited grazing for livestock. The forage is mainly annual grasses and forbs but includes a few perennial grasses, such as squirreltail and purple stipa. Because of the low ratio of calcium to magnesium in the soil, the stands of grass are thin and the forage is low in nutrients. The shrubs are mainly California holly, whiteleaf manzanita, and interior live oak. These provide cover and some browse for wildlife. Capability unit VIIs–9.

Myers Series

In the Myers series are deep, nearly level to moderately sloping soils that are well drained. These soils formed under annual grasses and forbs in alluvium derived mainly from sedimentary rock. They are on old alluvial fans and flood plains, mostly near Willows and in small valleys in the lower foothills. Elevations range from about 150 to 1,000 feet, and the average annual rainfall is about 15 to 20 inches.

The surface layer, a dark grayish-brown to dark-brown clay, is slightly acid but becomes neutral with increasing depth. It grades to dark-brown to brown, hard clay that is mildly alkaline. Below is brown or yellowish-brown, calcareous clay or clay loam that is several feet to many feet thick.

Myers soils are closely associated with soils of the Capay, Hillgate, Yolo, and Zamora series. They are lighter colored and better drained than the Capay soils, which are in shallow depressions. Along the edges of foothills and low terraces, Myers soils extend into large areas of Hillgate soils, but they are in slightly lower areas than those soils and lack the claypan typical of those soils. They are older than the Yolo and Zamora soils, which occupy stream ridges that extend into areas of the Myers soils.

Most areas of Myers soils are dryfarmed to barley in rotation with pasture. In areas where irrigation water is available, the soils are used mainly for rice, permanent pasture, milo, and field corn, but sugarbeets are grown in places. In the foothill valleys much of the acreage of these soils is used for annual range or pasture.

Myers clay, 0 to 3 percent slopes (MzrA).—Most of this soil is west of Willows. The areas are large and are in cultivated crops or are left fallow or the volunteer forage plants are used for range or pasture. In the foothill valleys the areas are smaller and have a cover of native annual grasses and forbs.

Representative profile:

0 to 29 inches, dark-brown, hard to extremely hard clay that is dark grayish brown to dark brown and firm to very firm when moist; very coarse prismatic primary structure of the kind characteristic of adobe soils; medium to very coarse angular blocky secondary structure; in many places the uppermost one-half inch develops a granular structure when dry; slightly acid but neutral with increasing depth.

29 to 43 inches, brown, extremely hard clay that is dark brown and very firm when moist; very coarse prismatic and coarse blocky structure; mildly alkaline; a few small nodules of lime.

43 to 60 inches +, yellowish-brown, hard, light clay that is dark yellowish brown and firm when moist; massive; mildly alkaline; in places lime is finely disseminated and segregated in tubular pores.

The surface layer is brown or dark brown to dark grayish brown, and the subsurface and substratum are brown or yellowish brown to dark yellowish brown. Texture is predominantly clay, but it is silty clay in places. The surface layer is slightly acid to neutral, and the layers below are mildly alkaline or moderately alkaline. Lime generally occurs in the lower horizons, though in some areas these horizons are only intermittently calcareous. In areas used for rice, the surface and subsurface are mottled because of the somewhat poor drainage.

Permeability of this soil is slow. Runoff is slow, and erosion is very slight or is not a hazard. The available water holding capacity is about 9 to 11 inches. Roots penetrate deeply into the soil. Fertility is high.

Much of the acreage of this soil is used for dryfarmed barley in rotation with pasture. In this rotation the forage consists of grain stubble and volunteer forage plants. Less extensive areas are dryfarmed to milo and safflower. The chief irrigated crops are rice, milo, and field corn, though some areas are in sugarbeets and permanent pasture. When the Tehama-Colusa Canal is completed, more water will be available for irrigating areas of this soil. Capability unit IIIs–5.

Myers clay, 3 to 10 percent slopes (MzrB).—This soil is on small, old alluvial fans in many small valleys in the lower foothills. The areas are somewhat concave and are below areas of soils formed in material from Cretaceous rock. Runoff is slow to medium, and the erosion hazard is slight to moderate. A few small streams flow through areas of this soil.

In many places this soil is associated with Hillgate, Tehama, Yolo, and Zamora soils, which are on terraces and recent alluvium.

All of this Myers soil is used for annual range or for dryfarmed grain in rotation with pasture. Capability unit IIIe–5.

Myers clay loam, 0 to 3 percent slopes (MzyA).—This soil is in the Sacramento Valley and in many small valleys in the foothills. In many places it is adjacent to Myers clay, 0 to 3 percent slopes. It is similar to that soil but has a surface layer of clay loam, and it generally is in slightly higher areas. Also, permeability of the surface soil is moderately slow. Use is about the same as for Myers clay, 0 to 3 percent slopes. Capability unit IIs–3.

Myers clay loam, 3 to 8 percent slopes (MzyB).—All of

this soil is in small valleys in the foothills. It is somewhat more permeable than Myers clay, 3 to 10 percent slopes, and is easier to cultivate, but it is otherwise similar to that soil. Use is also similar. Capability unit IIe–3.

Myers-Gullied land complex, 3 to 10 percent slopes (MzxB).—This complex is in small valleys in the lower foothills. It consists of areas of Myers clay in which the natural drainageways are deeper than normal as the result of erosion and are cut by gullies. In places short, tributary gullies have formed. The gullies are as much as 5 to 8 feet deep in places and cannot be crossed with farm equipment. The areas generally consist of a single gully along a drainageway.

Where this complex adjoins areas of other soils used for dryfarmed barley, it is farmed the same and the areas are cultivated to the edges of the gullies. If the areas adjoin steeper soils used for range, they generally are used for grazing. Capability unit IIIe–5.

Nacimiento Series

Soils of the Nacimiento series are well drained, moderately deep to deep, gently undulating to steep, and calcareous. They are underlain by softly consolidated siltstone and hard sandstone and shale. The vegetation consists of annual grasses and forbs, particularly wild oats, soft chess, and burclover. These soils are in the foothills at elevations of 200 to 800 feet, mainly near the Altamont and Contra Costa soils. Annual precipitation is 16 to 20 inches.

Nacimiento soils have a surface layer that is grayish-brown or light olive-brown silty clay, clay, or heavy clay loam. The subsoil is light olive-brown to light yellowish-brown silty clay or clay. The underlying bedrock is softly consolidated, moderately calcareous siltstone or fine-grained sandstone and shale.

These soils are used for dryfarmed small grain, annual range, and wildlife. Dove, pheasant, and deer are the main wildlife.

Nacimiento clay, 15 to 30 percent slopes (NaD).—This deep soil is in hilly areas on low foothills, mainly along the western edge of the Sacramento Valley.

Representative profile:

0 to 10 inches, grayish-brown, very hard clay that is olive brown and very firm when moist; granular structure in the uppermost 1 inch but coarse prismatic below; mildly alkaline and slightly calcareous; contains lime that is both finely disseminated and segregated in a few hard concretions.

10 to 41 inches, light olive-brown, very hard clay that is olive brown and firm when moist; very coarse prismatic and angular blocky structure; mildly alkaline to moderately alkaline and moderately calcareous; contains lime that is finely disseminated and also segregated in soft masses and small, hard concretions; in some places mycelium lime is in the lower part of this horizon.

41 inches +, pale-olive, softly consolidated, moderately calcareous siltstone.

The texture is silty clay or clay throughout, and the color is light olive brown, brown, or grayish brown. Depth to softly consolidated siltstone and fine-grained sandstone is 36 to 54 inches. In places Nomlaki tuff, a rhyolitic ash, crops out.

Included with this soil are small areas of Altamont clay, of Shedd silty clay loam, and Newville gravelly loam.

This Nacimiento soil is used for dryfarmed small grain, annual range, and wildlife. Wild oats, soft chess, and burclover are the dominant range plants. In some places dryfarmed safflower and sudangrass are grown. If water were available, this soil would be suitable for sprinkler irrigation. Capability unit IVe–5.

Nacimiento clay, 3 to 15 percent slopes (NaC).—Runoff on this soil is slow to medium, and the erosion hazard is slight to moderate. In some places Nomlaki tuff crops out.

This soil is used for dryfarmed small grain, annual range, and wildlife. If water were available, this soil would be suitable for sprinkler irrigation. The chief wildlife are doves, pheasants, and deer. Capability unit IIIe–5.

Nacimiento clay, 30 to 50 percent slopes (NaE).—On this soil runoff is rapid, and the erosion hazard is severe. In some places Nomlaki tuff crops out. All of this soil is used for annual range and wildlife. Capability unit VIe–5.

Nacimiento soils, 10 to 30 percent slopes (NcD).—From 60 to 80 percent of this mapping unit is Nacimiento clay, and 20 to 40 percent is Nacimiento clay loam. Nacimiento clay loam has a surface layer of heavy clay loam that is 4 to 6 inches thick, but it is otherwise similar to Nacimiento clay. Depth to hard calcareous sandstone and shale is dominantly 30 to 36 inches. Runoff is medium, and the erosion hazard is moderate.

These soils are used for dryfarmed small grain, annual range, and wildlife. If water were available, these soils could be sprinkler irrigated and a variety of crops could be grown. Capability unit IVe–5.

Nacimiento soils, 30 to 50 percent slopes (NcE).—These soils have stronger slopes, but they are otherwise similar to Nacimiento soils, 10 to 30 percent slopes. Runoff is rapid, and the erosion hazard is severe. All areas are used for annual range and wildlife. Capability unit VIe–5.

Nacimiento-Gullied land complex, 15 to 30 percent slopes (NdD).—This complex consists of deep Nacimiento clay that is cut by gullies 4 to 6 feet deep at intervals of 500 to 1,000 feet. Runoff is medium, and the erosion hazard is moderate.

This complex is used for dryfarmed small grain, annual range, and wildlife. Capability unit IVe–5.

Nacimiento-Gullied land complex, 30 to 50 percent slopes (NdE).—This complex consists of moderately deep Nacimiento clay that is cut by gullies 2 to 5 feet deep at intervals of 500 to 1,000 feet. Runoff is rapid, and the erosion hazard is severe.

This complex is used for annual range and wildlife. It is difficult for livestock to cross the gullies, and they do not graze the areas effectively. Capability unit VIe–5.

Nacimiento-Altamont-Gullied land complex, 15 to 30 percent slopes (NgD).—From 50 to 80 percent of this complex is Nacimiento clay, and from 20 to 50 percent is Altamont clay. Gullies, which are mainly in the Altamont soil, are 4 to 7 feet deep and are at intervals of 500 to 1,000 feet. The Nacimiento soil is mainly on ridgetops and convex side slopes, and the Altamont soil is mainly on concave slopes, saddles, and toe slopes. On all areas runoff is medium and the erosion hazard is moderate.

This complex is used for dryfarmed small grain, annual range, and wildlife. If water were available, these

soils would be suitable for sprinkler irrigation. Capability unit IVe–5.

Nacimiento-Contra Costa-Gullied land complex, 15 to 30 percent slopes (NkD).—Soils in this association are moderately deep to hard sandstone and shale. Runoff is medium, and the erosion hazard is moderate.

These soils are used for dryfarmed small grain, annual range, and wildlife. If water were available, these soils would be suitable for sprinkler irrigation. Capability unit IVe–5.

Nacimiento-Contra Costa-Gullied land complex, 30 to 50 percent slopes (NkE).—Soils in this complex are moderately deep to hard sandstone and shale. The areas are cut by gullies 3 to 5 feet deep at intervals of 500 to 1,000 feet. The gullies are mainly in the Contra Costa soil. Runoff is rapid, and the erosion hazard is severe. All areas of these soils are used for annual range and wildlife. Capability unit VIe–5.

Nacimiento-Altamont association, 10 to 30 percent slopes (NfD).—From 50 to 80 percent of this mapping unit is Nacimiento clay, and 20 to 50 percent is Altamont clay. The Nacimiento clay is on ridgetops and convex side slopes, and the Altamont clay is on concave slopes and saddles. Runoff is medium, and the erosion hazard is moderate.

These soils are used for dryfarmed small grain, annual range, and wildlife areas. If water were available, these soils would be suitable for sprinkler irrigation. Capability unit IVe–5.

Nacimiento-Contra Costa association, 3 to 15 percent slopes (NhC).—On these soils runoff is slow to medium, and the erosion hazard is slight to moderate.

These soils are used for dryfarmed small grain, annual range, and wildlife. If water were available, these soils would be suitable for sprinkler irrigation. Capability unit IIIe–5.

Nacimiento-Contra Costa association, 15 to 30 percent slopes (NhD).—From 50 to 80 percent of this mapping unit is Nacimiento clay, and from 20 to 50 percent is Contra Costa clay. The Nacimiento soil is on the ridgetops and convex side slopes, and the Contra Costa soil is on the concave side slopes and saddles. Both soils are moderately deep to hard sandstone and shale. Runoff is medium, and the erosion hazard is moderate.

These soils are used for dryfarmed small grain, annual range, and wildlife. If water were available, these soils would be suitable for sprinkler irrigation. Capability unit IVe–5.

Nacimiento-Contra Costa association, 30 to 50 percent slopes (NhE).—On these soils runoff is rapid, and the erosion hazard is severe. These soils are used for annual range and wildlife. Capability unit VIe–5.

Neuns Series

The Neuns series consists of hilly to very steep, shallow to deep soils that are well drained. These soils formed under conifers in material from greenstone and from associated metavolcanic basic rock. They are in mountainous areas in the western part of the county at elevations of 3,500 to 7,500 feet. The average annual precipitation is 35 to 60 inches, and much of it falls in winter as snow.

The surface layer is thin, dark-brown, brown, or grayish-brown loam or sandy loam that is gravelly or cobbly. The subsoil is similar in texture, but it is brown or yellowish brown. The soils are medium acid to very strongly acid throughout. Rock outcrops are common; they occupy as much as 25 percent of the surface in some areas. Depth to weathered bedrock ranges from 18 to more than 50 inches and varies within a short distance.

Neuns soils are used mainly for production of timber, though Christmas trees of high quality are grown on areas of young regrowth. The trees on these soils also protect the watershed and provide food and cover for wildlife.

Neuns cobbly loam, 30 to 50 percent slopes (NmE).—This moderately deep soil is mostly on slopes of Snow Mountain and St. John Mountain, in the southwest corner of the county, and on Black Butte, in the northwest corner.

Representative profile:

1 inch to 0, fresh and partly decomposed litter made up of pine needles and twigs.
0 to 3 inches, grayish-brown, soft cobbly loam that is very dark grayish brown and very friable when moist; strong, fine to medium, granular structure; strongly acid to very strongly acid.
3 to 13 inches, brown, slightly hard very gravelly loam that is dark brown and very friable when moist; moderate, medium, granular structure; very strongly acid.
13 to 27 inches, light yellowish-brown, slightly hard very gravelly loam that is yellowish brown and friable when moist; moderate, medium, granular structure; very strongly acid.
27 inches +, hard, fractured greenstone and associated metavolcanic basic rock; in places soil material and a few roots are in cracks between the rocks.

In color the surface layer ranges from grayish brown or brown to dark brown. The upper part of the subsoil is yellowish brown, brown, or light reddish brown, but the lower part is light yellowish brown, yellowish brown, or brownish yellow. These layers are gravelly or cobbly loam or sandy loam. They generally are more acid with increasing depth, but in places they are medium acid to very strongly acid throughout. Coarse fragments in the soil increase in size and amount with increasing depth. Depth to weathered bedrock ranges from 20 to 40 inches. In areas that are shallow to bedrock, the soil is more cobbly than in the deeper areas, and rocks crop out in more places.

Permeability is moderately rapid. The available water holding capacity is 3 to 5 inches. Runoff is medium to rapid, and the erosion hazard is severe. Root penetration is moderately deep to deep, and fertility is moderate.

Included with this soil are small areas of shallow, rocky Goulding soils and of other Neuns soils. Also included are a few areas of soils that have a light reddish-brown surface layer and a reddish-brown subsoil.

Neuns cobbly loam, 30 to 50 percent slopes, is used mainly for timber production. Because of the cobblestones and rock outcrops, it is difficult and expensive to build access roads into areas of this soil. At the higher elevations Christmas trees of high quality can be harvested from young stands of red and white firs. This soil is also used as watershed areas and wildlife habitats and for hunting, camping, and other recreational purposes. Capability unit VIs–7.

Neuns cobbly loam, 10 to 30 percent slopes (NmD).—This soil generally is on ridgetops or peaks at elevations

of more than 6,000 feet. Runoff is medium, and the erosion hazard is moderate.

Timber stands on this soil consist mainly of white and red firs. The areas are relatively inaccessible, and few of them have been logged. Christmas trees of high quality can be harvested from stands of young regrowth. Areas of this soil are also used for watershed protection, wildlife habitats, and recreation. Capability unit VIs–7.

Neuns cobbly loam, 50 to 65 percent slopes (NmF).—This moderately deep soil is on mountain slopes and on sharp breaks to streams, generally at elevations of less than 6,000 feet. It supports open to semidense stands of various kinds of conifers, but in some places the stands also have an understory of manzanita and mountain whitethorn. This soil has steeper slopes and a few more coarse fragments throughout the profile, but it is otherwise similar to Neuns cobbly loam, 30 to 50 percent slopes. Rock outcrops occupy as much as 25 percent of the surface in some areas, but in most areas they cover less than 15 percent. Runoff is rapid to very rapid, and the erosion hazard is very severe.

This soil is used mainly for timber production. It is also used as watershed areas and for wildlife habitats. Capability unit VIIs–7.

Neuns cobbly loam, deep, 10 to 30 percent slopes (NnD).—This soil is on ridgetops and side slopes. Depth to bedrock ranges from 36 to 60 inches. This soil is relatively free of rock outcrops and is somewhat less cobbly than shallower Neuns soils. The available water holding capacity is 4 to 6 inches. Runoff is moderate, and the erosion hazard is slight to medium.

This soil is used chiefly for commercial production of timber. It supports open to semidense stands of various kinds of conifers. The stands consist mostly of Douglas-fir, ponderosa pine, sugar pine, and white fir but incense-cedar grows in some places. Capability unit VIs–7.

Neuns cobbly loam, deep, 30 to 50 percent slopes (NnE).—This soil is on side slopes, generally at elevations of less than 6,000 feet. Runoff is moderate to rapid, and the erosion hazard is moderate to severe.

This soil is well suited to trees. It is also used as watershed areas, as habitats for wildlife, and as recreation areas for campers and sportsmen. Capability unit VIs–7.

Neuns cobbly loam, shallow, 10 to 30 percent slopes (NoD).—This soil is on moderately steep side slopes or gently rolling to hilly ridgetops. It is more cobbly than Neuns cobbly loam, 10 to 30 percent slopes. Depth to bedrock ranges from 10 to 24 inches, and in places as much as 50 percent of the surface soil has been removed through erosion. Rocks crop out in many places. The available water holding capacity is 2 to 4 inches. Runoff is moderate, and the erosion hazard is also moderate.

This soil is fairly well suited to trees. Because of the many outcrops of rock and the many coarse fragments in this soil, it is difficult to build access roads into the areas. Young stands of red and white firs in a few areas at higher elevations are suitable for Christmas trees. Capability unit VIs–7.

Neuns cobbly loam, shallow, 30 to 50 percent slopes (NoE).—This soil is on mountain slopes under open to semidense stands of conifers and brush. Runoff is rapid.

This soil is fairly well suited to trees. If accessible, areas at elevations of more than 6,000 feet are suitable for Christmas trees. This soil is also used for wildlife habitats and watershed purposes. Capability unit VIs–7.

Newville Series

Soils of the Newville series are undulating to very steep, gravelly, and well drained. These soils formed in material from weakly consolidated sediments of the Tehama formation and of other similar formations. The sediments consist of poorly sorted, interbedded gravel and cobblestones in a matrix of noncalcareous sandy clay. Newville soils are on dissected terraces, mainly in the north-central part of the county (fig. 6). The vegetation is mostly annual grasses and forbs, but blue oaks grow in some places. Elevations range from 250 to 1,250 feet, and average annual rainfall is 16 to 25 inches.

The surface layer, a brown gravelly loam, abruptly overlies brown to reddish-brown gravelly clay. The gravel increases in amount and size with increasing depth. It is mainly quartzite and varicolored chert but includes some fragments of sandstone, conglomerate, and greenstone. The surface layer and subsoil are slightly acid to medium acid, and the substratum is slightly acid to very mildly alkaline.

These soils are associated with the Corning and Redding soils, on old terraces, and are similar to them. They are not so red as those soils and are less acid. They also lack the hardpan typical of the Redding soils. In many places Newville soils are also associated with the calcareous Altamont, Nacimiento, and Shedd soils, which formed in material from fine-textured, nongravelly strata of the Tehama formation.

Newville soils are used mainly as early range for sheep and cattle. Some of the more gently sloping areas are dryfarmed to barley in rotation with pasture.

Newville gravelly loam, 15 to 30 percent slopes (NvD).—This soil is on dissected terraces. The vegetation is mostly annual grasses and forbs or annual grasses and blue oaks that include a few shrubs.

Representative profile:

0 to 15 inches, brown, hard gravelly loam that is dark brown and friable when moist; massive; in many places the upper part is platy; slightly acid to medium acid.

15 to 26 inches, brown to reddish-brown, very hard gravelly clay that is dark brown to dark reddish brown and very

Figure 6.—Typical landscape of the Newville soils on slopes of dissected terraces; in the background on the Orland Buttes are the Tcomes soils.

firm when moist; coarse, prismatic structure, but subangular blocky with increasing depth; slightly acid to medium acid.

26 to 48 inches +, light yellowish-brown, light reddish-brown, and brown, very hard and stratified very gravelly clay, sandy clay, and sandy clay loam that are yellowish brown, reddish brown, and brown and very firm when moist; massive; slightly acid, but neutral to mildly alkaline with increasing depth; many feet thick.

On south-facing slopes where areas are under grass, the surface layer ranges from brown to yellowish brown or pale brown in color. On north-facing slopes where the areas are under stands of blue oaks, the color of the surface layer ranges from brown to grayish brown or dark grayish brown. The subsoil generally is redder in color; it ranges from brown or strong brown to reddish brown or yellowish red. Texture in the surface layer is gravelly sandy loam, loam, or sandy clay loam, and in the subsoil it is gravelly sandy clay or clay. Gravel makes up as much as 35 percent of the surface soil, by volume, and from 30 to 50 percent of the subsoil. In some places a few cobblestones are on the surface or in the soil profile just above the dense clay subsoil. Depth to the claypan ranges from 8 to 20 inches. The material just below the subsoil is more yellow and less red than the subsoil and is slightly acid to mildly alkaline. It consists of stratified gravelly and cobbly sediments, which range in texture from sandy loam and loam to sandy clay loam and sandy clay.

In places water stands above the dense claypan for short periods during the wet months in winter and spring, but this soil otherwise is well drained. Permeability is moderate in the surface layer and slow in the subsoil. Runoff is medium, and the erosion hazard is moderate. The available water holding capacity is 4 to 6 inches.

Included with this soil are narrow stringers of Arbuckle and Cortina soils and of Riverwash, along drainageways. Also included are small areas of Corning soils, on some of the less steep ridgetops.

Most of this Newville soil is used as early range for sheep and cattle, but a small acreage is dryfarmed to barley in rotation with pasture.

The forage on the range consists mostly of annual grasses and forbs. Filaree is the main forage plant on areas free of oaks. Annual grasses, mainly bromes and various kinds of annual forbs, are the chief forage plants in areas where trees grow. Dryfarmed grain should not be fertilized because of the uncertainty of adequate rainfall in spring. Capability unit VIe–3.

Newville gravelly loam, 3 to 15 percent slopes (NvC).—On this soil runoff is slow to medium, and the erosion hazard is moderate.

Included with this soil are small areas of Corning gravelly loam. These included soils are nearly level and generally are on terrace remnants above areas of Newville soils.

This Newville soil is used as early range for sheep and cattle. The acreage in dryfarmed barley is larger than that of other Newville soils that have similar or steeper slopes. Capability unit IVe–3.

Newville gravelly loam, 30 to 50 percent slopes (NvE).—On this soil runoff is rapid, and the erosion hazard is high.

Included with this soil are narrow stringers of Arbuckle and Cortina soils and of Riverwash, along drainageways. Also included are a few small areas of Altamont, Nacimiento, and Shedd soils.

All of this Newville soil is used for range. Many areas have open stands of blue oaks on them that include a few scattered shrubs, mainly common manzanita and buckbrush. In most places the shrubs are mature and are dying out. The forage growing beneath the oaks is of poorer quality than that in open areas. Capability unit VIIe–3.

Newville gravelly loam, 50 to 65 percent slopes, eroded (NvF2).—This soil is mainly in a few areas on slopes that face northwest. The areas are along the south side of Stony Creek, west of the Orland Buttes. This soil is steeper than Newville gravelly loam, 15 to 30 percent slopes, and has a thinner surface soil. Because of the very steep slopes, the soil tends to creep downslope. Drainage is somewhat excessive. Runoff is very rapid, and the erosion hazard is very severe.

All of this soil is used for range. The blue oaks on this soil must be retained to help control further erosion. Capability unit VIIe–3.

Newville-Gullied land complex, 8 to 30 percent slopes (NwD).—This complex consists of areas of Newville gravelly loam, 3 to 15 percent slopes, and Newville gravelly loam, 15 to 30 percent slopes, that are cut by gullies. The gullies are 4 to 7 feet deep and are at intervals of 500 to 1,000 feet.

Included with this complex are narrow stringers of Arbuckle and Cortina soils, along drainageways. Also included are small areas of Corning soils, on some of the less steep ridgetops.

Most of this complex is used for range. Some areas are dryfarmed to barley. The deep gullies cannot be crossed with farm machinery, however, and it is more difficult to farm areas of this unit than areas of Newville soils that are not gullied. Capability unit VIe–3.

Newville-Gullied land complex, 30 to 50 percent slopes (NwE).—This complex consists of Newville gravelly loam, 30 to 50 percent slopes, that is cut by gullies. The gullies are 4 to 7 feet deep and are at intervals of 500 to 1,000 feet.

All of this complex is used for range. Capability unit VIIe–3.

Newville-Lodo-Gullied land complex, 30 to 50 percent slopes (NxE).—From 50 to 80 percent of this complex is Newville gravelly loam, 30 to 50 percent slopes, and the rest is Lodo shaly loam on 30 to 50 percent slopes. The areas are cut by gullies that are 1 to 3 feet deep and are at intervals of 500 to 1,000 feet. The gullies are mainly in the Lodo soil. Runoff is rapid, and the erosion hazard is severe to very severe. The water-holding capacity is 3 to 4 inches for the Newville soil and 1 to 2 inches for the Lodo soil.

This complex is better suited to range than to other uses. Capability unit VIIe–3.

Orland Series

The Orland series consists of shallow to very deep, well-drained to somewhat excessively drained soils. These soils are on recent stratified alluvium from schistose, sedimentary, and metavolcanic rocks. They are along Stony Creek and its major tributaries on low benches or flats that are slightly above the stream channels. Areas

not protected by levees or dams are subject to annual overflow when the streams are at flood stage. Elevations range from 125 to 1,200 feet, and average annual rainfall is 16 to 25 inches.

The surface layer characteristically is light grayish brown or grayish brown, medium textured, and neutral. The subsoil is similar in color or is slightly lighter and generally is stratified and intermittently calcareous. Depth to river sand and gravel varies.

Orland soils are associated with the gravelly Cortina soils and are near areas of Gravelly alluvial land and of Riverwash. They are in the same general area as the Wyo soils, which are on slightly older alluvium.

Many kinds of crops are grown successfully on the Orland soils. The deeper soils are used chiefly for alfalfa, orchards, and irrigated row and field crops, and the shallow soils are used mostly for barley or range.

Orland loam (0 to 2 percent slopes) (Oa).—This deep soil occupies many long, narrow areas that are small and medium in size. The vegetation consists of open to semidense stands of willows, cottonwoods, and valley oaks that have an undergrowth of bushes, vines, annual grasses, and weeds. Most areas formerly were subject to frequent flooding. This hazard has been almost eliminated in areas downstream from the site of the Black Butte Dam, which was completed recently.

Representative profile:

0 to 11 inches, grayish-brown, slightly hard loam that is dark grayish brown and friable when moist; massive except for the uppermost inch, which is platy in places; in places the ped faces have a silvery sheen; neutral.

11 to 39 inches, grayish-brown, slightly hard to loose loam and silt loam that is dark grayish brown and friable when moist; stratified with a few thin lenses of fine sand and gravel; massive; in places the ped faces have a silvery sheen; rust-brown mottles are in the silt loam strata above the sand lenses; neutral, but mildly alkaline with increasing depth.

39 inches +, varicolored sand and gravel; loose and structureless; mildly alkaline.

The surface layer ranges from light brownish gray or grayish brown to gray, and the subsoil ranges from grayish brown, light brownish gray, or light olive brown to light yellowish brown. The surface layer is loam or silt loam that generally is free of gravel. The subsoil generally is stratified and the thickness of the strata varies greatly. Depth to the underlying sand and gravel ranges from 36 to 60 inches. The soil is more alkaline with increasing depth. It ranges from very slightly acid or neutral in the surface layer to mildly alkaline in the lower part of the subsoil. In many places the subsoil is intermittently calcareous at a depth below 36 inches.

Drainage is good. Permeability is moderate to the underlying sand and gravel and very rapid below. The available moisture holding capacity is 7 to 10 inches. Runoff is slow, and erosion is very slight or is not a hazard. Fertility is moderately high. Most areas formerly were subject to flooding during periods of peak runoff. The flooding hazard has now been almost eliminated on areas downstream from Black Butte Dam, which was completed recently.

Included with this soil are small stringers and other areas of shallow Orland soil and of gravelly Cortina soils.

Orland loam is well suited to many kinds of irrigated field, truck, and orchard crops. A few areas are dryfarmed to barley, and some undeveloped areas are used for pasture or range. Capability unit IIs–0.

Orland loam, very deep (0 to 1 percent slopes) (Od).—This soil occupies a large area north of the Graves Cemetery and a few small- and medium-sized areas widely scattered along the course of Stony Creek. It is more than 50 inches deep over river sand and gravel. Lime is below a depth of 40 inches. Permeability is moderate, and drainage is good. Runoff is slow. The available water holding capacity is 8 to 10 inches. The hazard of flooding has been almost eliminated on areas downstream from the site of the Black Butte Dam.

This soil is used for the same irrigated and dryfarmed crops as Orland loam. Crop growth is more uniform because of the greater depth of this soil. Capability unit I–1.

Orland loam, deep over claypan (0 to 1 percent slopes) (Odp).—This soil occupies three areas east of Orland that range from about 20 to 35 acres in size. It is 20 to 40 inches thick over Hillgate or Kimball soils that have a claypan. Depth to the claypan ranges from 30 to 50 inches. Runoff is slow. Permeability is moderate in the Orland soil and slow in the claypan soils.

Many shallow and moderately deep rooted truck, field, forage, and orchard crops are well suited to this soil. Irrigation must be carefully regulated to keep a perched water table from forming above the claypan. Capability unit IIs–3.

Orland loam, moderately deep over claypan (0 to 1 percent slopes) (Omp).—This soil consists of Orland loam that is 10 to 24 inches thick over Hillgate and Kimball soils that have a claypan. Runoff and permeability are slow.

Because of the claypan, this soil is better suited to shallow-rooted, irrigated field and forage crops than to other crops. Shallow-rooted orchard crops can be grown, but irrigation must be carefully regulated to keep a perched water table from forming above the claypan. Capability unit IIIs–3.

Orland loam, moderately deep over gravel (0 to 2 percent slopes) (Omr).—This soil consists of Orland loam that is 20 to 36 inches thick over river sand and gravel. It occupies many areas that are irregular in shape and range from less than 3 to more than 100 acres in size. The areas generally are on low benches near or adjacent to Stony Creek. They are widely scattered along the entire course of Stony Creek, but most areas are along the stream east of the Orland Buttes. Areas above Black Butte Dam are subject to flooding during periods of peak runoff.

Included with this soil are small areas of Cortina soils and of Riverwash.

Areas of this Orland soil west of the Orland Buttes are used for dryfarmed grain and pasture. Downstream from Black Butte Dam, the areas are used for irrigated forage, row, and orchard crops. Growth of crops is uneven because of the variable depth to the underlying sand and gravel and because of the included small areas of gravelly Cortina soils. Because of their irregular shape and small size, many areas of this soil are difficult to manage. Capability unit IIIw–0.

Orland loam, moderately deep over gravelly loam (0 to 1 percent slopes) (Oms).—This soil occupies an area west of Mills Orchard. It consists of Orland loam that

is 20 to 36 inches thick over Arbuckle gravelly loam. Permeability is moderate. Runoff is slow, and the available water holding capacity is 7 to 9 inches.

This soil is suited to the same crops as Orland loam, very deep. Capability unit I–1.

Orland loam, shallow over gravel (0 to 2 percent slopes) (Osg).—This soil consists of recent, somewhat stratified, medium-textured alluvium that is 10 to 20 inches thick over river sand and gravel. The areas are on low benches along Stony Creek, north of Orland. They formerly were subject to frequent overflow, but this hazard has been almost eliminated since completion of Black Butte Dam. Some areas are dissected by narrow channels. The vegetation on this soil consists chiefly of annual grasses and weeds but includes some scattered willows, cottonwoods, valley oaks, and shrubs.

Except for a few areas that are cultivated, these soils are used mainly for range. Becuse they are shallow, they are better suited to sprinkler irrigation than to flood irrigation. Under sprinkler irrigation, pasture plants and some shallow-rooted field crops can be grown successfully. If the areas are small and narrow and are associated with other Orland soils or Cortina soils, it is not practical to manage them separately. Capability unit IVs–4.

Orland loam, shallow over gravelly loam (0 to 1 percent slopes) (Osm).—This soil consists of Orland loam that is 10 to 24 inches thick over Arbuckle gravelly loam. It occupies four areas that are 10 to 50 acres in size and are north and east of Orland. Permeability is moderate. Runoff is slow, and the available water holding capacity is 8 to 9 inches.

This soil is used for orchards and for shallow- and deep-rooted forage and row crops. Capability unit IIs–4.

Orland loam, shallow over gravel, overflow (0 to 3 percent slopes) (Owo).—This soil consists of stratified, medium- and coarse-textured soil material that is 10 to 24 inches thick over river sand and gravel. It is on low benches or islands in the streambed of Stony Creek and is subject to frequent overflow during periods of peak runoff. The vegetation consists chiefly of annual grasses and weeds, but willows, cottonwoods, tamarisks, and low shrubs grow in a few places. The erosion hazard is severe. Many areas are dissected by narrow stream channels and include small areas of Cortina soils and of Riverwash.

All of this Orland soil is used for range. Variability in depth and texture and the hazards of flooding and severe erosion make cultivation impractical. Capability unit VIw–1.

Orland-Cortina complex (0 to 2 percent slopes) (Ox).—From 60 to 80 percent of this complex is Orland loam, moderately deep over gravel, and the rest is Cortina gravelly fine sandy loam. The areas are on a few low benches along Stony Creek, between Stonyford and Stony Gorge Reservoir. During times of peak runoff, these soils are flooded occasionally and have an intermittent high water table. The vegetation consists of open to semidense stands of valley oaks, cottonwoods, and willows that have undergrowth of low shrubs, vines, and annual grasses and weeds.

Most areas of this soil have been cleared or are partly cleared. The areas are used chiefly for dryfarmed grains and range. Because of differences in texture of the soils that make up this complex, crop growth is uneven. Irrigation water can be applied more uniformly by sprinklers than by surface irrigation. Capability unit IIIw–0.

Parrish Series

The Parrish series consists of shallow to moderately deep, rolling to very steep, gravelly soils that are well drained to somewhat excessively drained. These soils formed in material from slightly metamorphosed sandstone and shale or from sericite schist. They are in mountainous areas at elevations of 1,200 to 3,500 feet. The vegetation is trees and annual grasses or is shrubs. Blue oaks are the principal trees, and bromes and fescues are the dominant grasses. Chamise, ceanothus, manzanita, and mountain mahogany are the common shrubs. The average annual precipitation is 25 to 40 inches.

These soils are associated mainly with soils of the Josephine, Los Gatos, Maymen, Millsholm, and Yorkville series.

The surface layer, a brown gravelly loam, grades to gravelly clay loam with increasing depth. It overlies reddish-brown gravelly clay. Depth to the underlying rock ranges from 15 to 48 inches. The soils are slightly acid to strongly acid, and acidity increases with increasing depth.

Parrish soils are used for pasture and range and for water supply and wildlife purposes.

Parrish gravelly loam, 30 to 50 percent slopes (PaE).—This moderately deep soil is on mountain slopes.

Representative profile:

0 to 11 inches, brown, hard gravelly loam that grades to gravelly clay loam with increasing depth and is dark brown and friable when moist; weak, platy structure in the upper 1 to 2 inches, moderate, subangular blocky below; slightly acid to medium acid.

11 to 25 inches, reddish-brown, very hard gravelly clay that is yellowish red to dark red and friable when moist; moderate, angular blocky structure; strongly acid.

25 inches, slightly metamorphosed sandstone and shale.

The surface layer ranges from pale brown or brown to light yellowish brown and is 15 to 25 percent gravel. The subsoil ranges from gravelly clay to gravelly clay loam and is 30 to 45 percent gravel. Depth to bedrock ranges from 20 to 48 inches, but it generally is 25 to 35 inches. The surface layer is slightly acid to medium acid, and the subsoil is medium acid to strongly acid.

This soil is used for annual range, wildlife, and water supply. Capability unit VIIe–3.

Parrish gravelly loam, shallow, 30 to 50 percent slopes (PbE).—Most of this soil is on south-facing slopes. Depth to bedrock is 15 to 24 inches. The available water holding capacity is 2 to 3 inches. Large rocks crop out in a few places.

This soil is mostly under annual grasses, but a few blue oaks grow on the areas. It is used for annual range, as watershed areas, and as habitats for wildlife. Capability unit VIIe–3.

Parrish gravelly loam, shallow, 50 to 65 percent slopes (PbF).—Most of this soil is on south-facing slopes. Drainage is somewhat excessive. Runoff is very rapid, and the erosion hazard is very severe.

This soil is mostly under annual grasses and blue oaks. It is used for annual range and for water supply and wildlife purposes. Capability unit VIIe–3.

Parrish-Gullied land complex, 10 to 30 percent slopes (PcD).—This complex consists of Parrish gravelly loam, shallow, 10 to 30 percent slopes, that is cut by gullies. The gullies are 2 to 4 feet deep and 500 to 1,000 feet apart. Runoff is medium, and the erosion hazard is moderate.

All of this complex is under annual grasses and blue oaks. The areas are used for annual range, wildlife, and water supply. The soils in this complex are suited to dryfarmed barley, but the deep gullies make cultivating and harvesting difficult. Capability unit VIe–3.

Parrish-Gullied land complex, 30 to 50 percent slopes (PcE).—This complex consists of Parrish gravelly loam, shallow, 30 to 50 percent slopes, that is cut by gullies. The gullies are 2 to 5 feet and are at intervals of 500 to 1,000 feet. Rocks crop out in a few places.

Annual grasses and blue oaks are the chief kinds of plants on this complex, but Digger pines grow in a few places. The areas are used for range, wildlife, and water supply. The gullies hinder grazing. Capability unit VIIe–3.

Parrish-Yorkville-Gullied land complex, 10 to 30 percent slopes (PdD).—From 50 to 60 percent of this complex is Parrish gravelly loam, shallow, 10 to 30 percent slopes, and 30 to 40 percent is Yorkville clay loam on 10 to 30 percent slopes. Gullies 3 to 5 feet deep and 500 to 1,000 feet apart cut the areas.

Included with this complex are small areas of Millsholm gravelly loam. This included soil makes up from 10 to 20 percent of each area.

All of this complex is under annual grasses and blue oaks. The areas are used for range, wildlife, and water supply. The gullies interfere with tillage, but otherwise the soils in this complex are suited to dryfarmed small grain. Capability unit VIe–3.

Parrish-Yorkville-Gullied land complex, 30 to 50 percent slopes (PdE).—This complex is in steeper areas but otherwise is similar to Parrish-Yorkville-Gullied land complex, 10 to 30 percent slopes. Runoff is rapid, and the erosion hazard is severe.

Areas of this complex are mainly under annual grasses and forbs, but blue oaks grow in a few places. The areas are used for annual range, wildlife, and water supply. Capability unit VIIe–3.

Perkins Series

In the Perkins series are nearly level to very gently sloping, gravelly soils that are well drained. These soils formed in gravelly alluvium washed from sedimentary and metamorphic rocks. They are mostly on remnants of high terraces along the western edge of the foothills, between the Colusa County line and Newville. Elevations range from 500 to 1,300 feet. The vegetation is annual grasses and blue oaks or thick stands of brush. The average annual rainfall is 20 to 30 inches.

The surface layer, a brown gravelly loam that is slightly acid to medium acid, overlies reddish-brown gravelly or very gravelly clay loam that is slightly acid to medium acid. Below is reddish-brown, medium-textured or moderately fine textured material. This material is very gravelly and cobbly and is unconsolidated and permeable.

These soils are associated chiefly with soils of the Corning and Newville series, which are also gravelly but have a claypan.

Perkins gravelly loam, 0 to 3 percent slopes (PeA).—This deep soil is on remnants of prominent high terraces, mainly near Elk Creek and Stonyford.

Representative profile:

0 to 14 inches, brown to reddish-brown, slightly hard gravelly loam that is dark brown to dark reddish brown and friable when moist; the gravel is mainly angular fragments of quartzite and schistose rocks; massive; medium acid.

14 to 46 inches, reddish-brown, hard gravelly light clay loam that is very gravelly clay loam with increasing depth and is dark reddish brown to dark red and firm when moist; massive; slightly acid to medium acid; silver sheen is on the surfaces of the gravel and pores.

46 to 60 inches +, reddish-brown, hard very gravelly sandy clay loam that contains cobblestones in places and is dark reddish brown to dark red and firm when moist; silver sheen is on the surfaces of the gravel and cobblestones; massive; medium acid to strongly acid.

The surface layer is brown or reddish-brown slightly gravelly or gravelly loam. It is slightly acid to medium acid. The subsoil is reddish-brown or yellowish-red gravelly or very gravelly clay loam, sandy clay loam, or light clay. Below is reddish-brown or yellowish-red clay loam or sandy clay loam that is very gravelly and contains varying amounts of cobblestones.

In reaction the subsoil and substratum range from slightly acid to strongly acid. The gravel increases in size and amount with increasing depth. It makes up 15 to 25 percent of the surface soil and 25 to 55 percent of the subsoil, by volume. In the substratum gravel and cobblestones make up more than 50 percent of the soil mass, by volume.

Permeability of this soil is moderate to moderately slow. Runoff is slow, and the erosion hazard is slight. The available water holding capacity is 5 to 7 inches. Root penetration is deep, and fertility is medium.

Perkins gravelly loam, 0 to 3 percent slopes, is used mainly for grazing. The forage is annual grasses and forbs that consists mainly of wild oats, fescues, and soft chess and other bromes. A few areas are dryfarmed to barley in rotation with pasture, and a small acreage west of Elk Creek is in almond orchards.

Areas under dense stands of brush, mainly chamise, provide some browse for wildlife and livestock. These areas can be improved by burning off the brush and planting the areas to grass. Capability unit IIs–4.

Perkins gravelly loam, 3 to 15 percent slopes (PeC).—On this soil runoff is slow to medium and the erosion hazard is slight to moderate.

Most areas of this soil remain in stands of blue oaks and common manzanita. They are used mainly for annual range. A few cleared areas are dryfarmed to barley in rotation with pasture. Capability unit IIe–4.

Plaza Series

Soils of the Plaza series are nearly level and are somewhat poorly drained. These soils formed in alluvium washed mainly from schistose and sedimentary rocks. They are on the lower part of old alluvial fans that border poorly drained soils in basins or extend into them. The areas are in the eastern part of the county at elevations of 90 to 175 feet. The native vegetation was chiefly annual grasses and forbs, but plants that could

tolerate salts and alkali grew on some areas. The average annual rainfall is 16 to 20 inches.

The surface layer is light brownish gray or grayish brown. It is medium textured or moderately fine textured and is slightly acid or medium acid. The subsoil is light olive brown or light yellowish brown. It is moderately fine textured and ranges from neutral in the upper part to mildly alkaline and slightly calcareous in the lower part. The substratum is light yellowish-brown or pale-brown, mottled material that is moderately fine textured and is moderately alkaline and calcareous. In places the soil contains slight to moderate amounts of salts and alkali and has a substratum that is cemented with lime and silica at a moderate depth. The cemented substratum varies in thickness and hardness.

These soils generally are associated with the well-drained Tehama soils and the poorly drained Willows soils.

Plaza soils are used mainly for rice and irrigated pasture, but many areas are in ladino clover, milo, corn, sudangrass, and other irrigated crops. Dryfarmed areas generally are used for barley and safflower or are used for range.

Plaza silt loam (0 to 2 percent slopes) (Pf).—This nearly level soil is on the lower edges of old alluvial fans of Stony Creek. It is in the valley part of the county, and the largest acreages are in the districts of Bayliss and Fairview and east of Artois and Willows.

Representative profile in a fallowed ricefield:

0 to 10 inches, light brownish-gray, hard silt loam that is dark grayish brown and firm when moist; distinct, strong-brown mottles; subangular blocky structure; medium acid.

10 to 34 inches, light olive-brown, very hard clay loam that is dark grayish brown and very firm when moist; distinct, strong-brown mottles; angular and subangular blocky structure; neutral in the upper part but moderately alkaline and slightly calcareous in the lower part; lime is finely disseminated and also is segregated in small, soft masses.

34 to 60 inches +, light yellowish-brown clay loam and silty clay loam that are mottled with light gray and pale yellow with increasing depth and that are olive brown and grayish brown and friable when moist; distinct, strong-brown mottles; massive; moderately alkaline and strongly calcareous; lime is finely disseminated and also is segregated in small, soft masses and hard concretions.

The surface layer, a light brownish-gray or grayish-brown silt loam or loam, is 8 to 14 inches thick and is slightly acid or medium acid. The subsoil is light olive-brown, brown, or light yellowish-brown clay loam or silty clay loam 15 to 28 inches thick. It is neutral to moderately alkaline and is slightly calcareous in the lower part. The substratum is light yellowish brown and has mottles of light gray, light brownish gray, pale yellow, or light olive brown in the lower part. It is clay loam, silty clay loam, or silt loam, is somewhat stratified, and is moderately alkaline and slightly calcareous to strongly calcareous. Lime is finely disseminated and also is segregated in soft masses and hard concretions in the lower part of the subsoil and in the substratum.

In areas used for rice or for irrigated pasture for many years, strong-brown mottles occur in the surface layer, in the upper part of the subsoil, and in the horizons below. In areas used for rice, the surface layer generally is more acid than typical because ammonium sulfate fertilizer has been used on the areas for long periods.

Permeability of this soil is moderately slow. Runoff is slow to very slow, and erosion is not a hazard. The available water holding capacity is 9 to 11 inches. Root penetration is deep, and fertility is moderate.

Included with this soil are small areas of pale-brown Tehama soils. Also included are small areas of other Plaza soils that have a weakly cemented hardpan or are slightly affected by salts and alkali.

Plaza silt loam is used mostly for rice and irrigated pasture. Less extensive irrigated areas are in milo, corn, sudangrass, ladino clover, alfalfa, and similar crops. Dryfarmed areas are used for barley or safflower. Because of the intermittent high water table during the growing season, areas of this soil used for rice are poorly suited to trees or other deep-rooted crops. Capability unit IIIw–3.

Plaza silt loam, slightly saline-alkali (0 to 2 percent slopes) (Pfa).—From 5 to 20 percent of the surface area of this soil is slightly to strongly affected by soluble salts and alkali, but this soil is otherwise similar to Plaza silt loam.

Included with this soil are small areas of Plaza silt loam or Plaza silty clay loam, which have a substratum that is weakly cemented with silica and lime.

This Plaza soil is used for the same crops as Plaza silt loam. Stands of crops are uneven because of the excess salts and alkali. Capability unit IIIw–3.

Plaza silty clay loam (0 to 2 percent slopes) (Pg).—This soil has a surface layer of light silty clay loam, but it is otherwise similar to Plaza silt loam. Use is the same. Capability unit IIIw–3.

Plaza silty clay loam, slightly saline-alkali (0 to 2 percent slopes) (Pga).—From 5 to 20 percent of the area of this soil is affected by excess salts and alkali, and the surface layer is a light silty clay loam. This soil is otherwise similar to Plaza silt loam, slightly saline-alkali. Use is the same. Capability unit IIIw–3.

Plaza silt loam, dense subsoil (0 to 2 percent slopes) (Ph).—This soil has a substratum that is weakly cemented with lime and silica at a depth of 20 to 40 inches. This indurated layer varies in hardness and ranges from 3 to 15 inches in thickness. It generally is thicker at the shallower depths and in a few places has a very thin, extremely hard layer of lime on its surface. The cemented horizon is not continuous in all areas of this soil, but it limits development of roots and movement of water. Permeability is slow to very slow.

This soil is used chiefly for rice and irrigated pasture. Less extensive irrigated areas are in milo, corn, ladino clover, sudangrass, and similar shallow-rooted crops. A small acreage is in alfalfa. Dryfarmed areas are used for barley and safflower or as range for sheep. Capability unit IIIw–3.

Plaza silt loam, dense subsoil, slightly saline-alkali (0 to 2 percent slopes) (Pha).—From 5 to 20 percent of the surface area of this soil is slightly to strongly affected by excess salts and alkali, but it is otherwise similar to Plaza silt loam, dense subsoil.

Crops grown on this soil are the same as those grown on Plaza silt loam, dense subsoil. Yields are slightly lower because of the areas affected by salts and alkali. Capability unit IIIw–3.

Plaza silty clay loam, dense subsoil (0 to 2 percent slopes) (Pk).—This soil has a surface layer of light silty

clay loam, but it is otherwise similar to Plaza silt loam, dense subsoil. Use is the same. Capability unit IIIw–3.

Plaza silty clay loam, dense subsoil, slightly saline-alkali (0 to 2 percent slopes) (Pka).—From 5 to 20 percent of the surface area of this soil is affected by excess salts and alkali, and the surface layer is a light silty clay loam. This soil is otherwise similar to Plaza silt loam, dense subsoil.

This soil is used chiefly for rice and irrigated pasture. Other crops grown include milo, corn, ladino clover, and dryfarmed barley and pasture. Capability unit IIIw–3.

Plaza silty clay loam, dense subsoil, moderately saline-alkali (0 to 2 percent slopes) (Pkb).—From 20 to 50 percent of the surface area of this soil is affected by excess salts and alkali, and the surface layer is a light silty clay loam. This soil is otherwise similar to Plaza silt loam, dense subsoil.

Most areas of this soil are used for rice and irrigated pasture. Reclaiming this soil is difficult, because it is in the rice-producing area of the county where there is an intermittent high water table during the growing season. Capability unit IIIw–6.

Pleasanton Series

In the Pleasanton series are nearly level to gently sloping, gravelly soils that are well drained. These soils formed in gravelly alluvium derived mainly from old gravelly terrace deposits washed from the Tehama formation and other similar formations. They are on alluvial fans and stream terraces. The areas are mainly west of Artois in the Sacramento Valley and in the narrow valleys of the northern foothills. Elevation ranges from 150 to 600 feet. The vegetation is annual grasses and forbs or is blue oaks and grasses with shrubs in some places. The average annual rainfall is 15 to 20 inches.

The surface layer is grayish-brown to very dark grayish-brown, gravelly material that is moderately coarse textured to moderately fine textured. Below is grayish-brown or brown, gravelly material that is moderately fine textured. The substratum is brown or yellowish brown, is gravelly or very gravelly, and is medium textured or moderately fine textured. Reaction is slightly acid to medium acid throughout.

In the Sacramento Valley Pleasanton soils are associated with the Arbuckle, Artois, and Capay soils. In the foothills Pleasanton soils are associated chiefly with the Newville and Arbuckle soils.

Most areas of Pleasanton soils are used as annual range for livestock, but some areas are dryfarmed to small grain in rotation with pasture. The chief irrigated crops are shallow-rooted forage and field crops.

Pleasanton gravelly loam, 0 to 2 percent slopes (PmA).—This deep soil is west of Artois on old alluvial fans in the Sacramento Valley and on small fans and stream benches along minor streams of the foothills.

Representative profile:

0 to 11 inches, grayish-brown, slightly hard gravelly loam that is very dark grayish brown and friable when moist; the gravel consists mainly of quartzite and chert; massive; medium acid.

11 to 30 inches, grayish-brown, hard gravelly sandy clay loam that is dark grayish brown and friable to firm when moist; the gravel consists mainly of quartzite and chert; massive; medium acid.

30 to 54 inches +, brown, hard gravelly sandy clay loam that is dark brown and firm when moist; massive but somewhat stratified; slightly acid to medium acid.

The surface layer generally is grayish brown or light brownish gray, but it may range to dark grayish brown under thick stands of blue oaks and shrubs. It is gravelly to very gravelly loam and is slightly acid to medium acid. The subsoil generally is browner than the surface layer and ranges from grayish brown or brown to yellowish brown. It is gravelly or very gravelly sandy clay loam, clay loam, or heavy clay loam and is slightly acid to medium acid. The substratum consists of brown or yellowish-brown gravelly or very gravelly loam or clay loam that is slightly acid or medium acid.

In places cobblestones are in the lower subsoil and substratum. The content of gravel varies somewhat but generally makes up 25 to 55 percent of the soil mass, by volume. In the foothills many areas have a thin layer of gravel on the surface.

Pleasanton gravelly loam is moderately permeable. Runoff is very slow or slow, and the erosion hazard is very slight. The available water holding capacity is 5 to 7 inches. Root penetration is deep.

Included with this soil are small areas of Artois and Arbuckle soils.

Areas of this Pleasanton soil in the foothills are used chiefly for annual range, but a few areas are dryfarmed to barley. Irrigated areas in the Sacramento Valley are used for milo, corn, pasture plants, sudangrass, ladino clover, and alfalfa. In areas not irrigated the chief crop is barley grown in rotation with native pasture. Capability unit IIs–4.

Pleasanton gravelly loam, 2 to 10 percent slopes (PmB).—This soil generally is on small alluvial fans. Runoff is slow to medium, and the erosion hazard is slight to moderate.

Most areas of this soil are used for annual range. A few areas are occasionally dryfarmed to small grain, mainly barley. Capability unit IIe–4.

Pleasanton gravelly sandy clay loam, 0 to 2 percent slopes (Pn).—This soil has a somewhat finer textured surface layer, but it is otherwise similar to Pleasanton gravelly loam, 0 to 2 percent slopes. It generally is on old alluvial fans, west of Artois, near areas of Artois gravelly loam or of Capay clay.

Most areas of this Pleasanton soil are too small to manage separately, and they are therefore used for the same crops as are grown on the adjacent soils. Barley is grown in rotation with annual pasture in areas not irrigated, and shallow-rooted field and forage crops are grown in irrigated areas. Capability unit IIs–4.

Pleasanton very gravelly sandy loam, 0 to 2 percent slopes (Po).—This soil has a coarser textured, more gravelly surface layer, but it is otherwise similar to Pleasanton gravelly loam, 0 to 2 percent slopes. The surface layer contains 45 to 60 percent gravel, by volume. The available water holding capacity is 4 to 6 inches.

Most areas of this soil are small or consist of narrow stringers. They are associated with other Pleasanton soils or with soils of the Artois and Capay series. The areas are too small to manage separately and are therefore used and managed the same as the associated soils. In areas where irrigation water is available, shallow-rooted

field and forage crops are grown. Areas not irrigated are cropped to barley, generally in rotation with pasture. Capability unit IIIs–4.

Polebar Series

The Polebar series consists of moderately steep to very steep, moderately deep soils that are well drained. These soils formed in material from sedimentary rocks of the Franciscan formation. The rock is mainly sandstone that is partly metamorphosed and in places is serpentinized along pressure faces. Polebar soils are in the southwest corner of the county at elevations of 1,000 to 3,500 feet. The vegetation consists of annual grasses or of blue oaks and annual grasses with Digger pines and California junipers growing in some places. The average annual rainfall is 25 to 40 inches.

The surface layer, a brown gravelly loam that contains some gravel and is slightly acid, overlies reddish-brown gravelly heavy clay loam or light clay that is slightly acid to neutral. Below is light-gray gravelly clay loam that is mildly alkaline and calcareous. The parent rock, which is at moderate depth, is partly weathered, grayish sandstone that contains thin seams of calcite. In places rocks crop out. Landslips occur in a few places.

Most areas of the Polebar soils are associated with soils of the Millsholm, Parrish, and Yorkville series and are along Open Ridge.

Polebar soils are used chiefly to provide summer grazing for livestock. They are also used for watershed purposes and as habitats for wildlife, mainly deer.

Polebar loam, 30 to 50 percent slopes (PpE).—This soil occupies areas along Open Ridge. Landslips occur in a few small areas and rocks crop out in some places.

Representative profile:

0 to 8 inches, brown, hard loam that contains a few pebbles and is dark brown and friable when moist; weak, subangular blocky structure; slightly acid.

8 to 21 inches, reddish-brown, very hard gravelly heavy clay loam that is dark brown in the lower part and is dark reddish brown to dark brown and very firm when moist; angular blocky to subangular blocky structure; slightly acid but mildly alkaline with increasing depth.

21 to 35 inches, light-gray, very hard gravelly clay loam that is olive gray and very firm when moist; weak, subangular blocky structure to massive; mildly alkaline and strongly calcareous; lime is finely disseminated and segregated in soft masses.

25 inches +, gray, fractured sandstone; partly metamorphosed in some places; a few calcite seams.

The surface layer is 5 to 15 inches thick. It is brown, dark-brown, or strong-brown slightly gravelly loam to light clay loam that is slightly acid to medium acid. The subsoil is dominantly reddish brown, but it ranges to dark brown or brown, particularly in the lower part. It is 6 to 16 inches thick and ranges from gravelly heavy clay loam to light clay in texture. It is slightly acid to neutral and is mildly alkaline in the lower part. The substratum, a light-gray or olive-gray gravelly clay loam, is mildly alkaline to moderately alkaline and calcareous. It ranges from 8 to 20 inches in thickness. Depth of the soil ranges from 20 to 40 inches, but it is dominantly 26 to 36 inches.

Metamorphism of the underlying rock is quite variable. The rock ranges from sandstone that is essentially unaltered to schistose rock. The gravel in the soil increases in amount and size with increasing depth. It makes up 15 to 25 percent of the surface layer and 20 to 45 percent of the subsoil and substratum, by volume. Rock outcrops generally cover less than 2 percent of the surface, but in places they occupy as much as 10 percent of the surface area.

Permeability of this soil is slow. Runoff is rapid, and the erosion hazard is severe. Root penetration is moderately deep, and the available moisture holding capacity is 4 to 5 inches. Fertility is low.

Included with this soil are small areas of Millsholm gravelly loams and of Yorkville clay loam.

This Polebar soil is used chiefly for spring and summer range. It is also used for watershed purposes and as recreational areas, chiefly for hunting deer. Herds of deer graze the areas throughout the year.

In many places roadcuts in this soil slump away, and roads in such areas require extra maintenance to keep them open. If drainage water is not properly diverted away from roadbeds, the water is likely to cut deep gullies into areas downslope. Capability unit VIIe–3.

Polebar-Gullied land complex, 30 to 50 percent slopes (PrE).—This complex consists of Polebar loam, 30 to 50 percent slopes, that is cut by gullies. The gullies are 3 to 5 feet deep and are at intervals of 500 to 1,000 feet.

Included with this unit are small areas of Millsholm gravelly loams and of Yorkville clay loam.

This complex is used about the same as Polebar loam, 30 to 50 percent slopes. The gullies make it somewhat more difficult for livestock to graze the areas. Capability unit VIIe–3.

Polebar-Millsholm-Gullied land complex, 30 to 50 percent slopes (PsE).—From 30 to 50 percent of this complex consists of Polebar loam, 30 to 50 percent slopes, and from 20 to 40 percent is Millsholm gravelly loam, 30 to 50 percent slopes. The areas are cut by a few gullies. The gullies are 2 to 5 feet deep and are 500 to 1,000 feet apart.

Included with this complex are small areas of Maymen, Parrish, and Yorkville soils. These included soils make up 10 to 20 percent of each area.

The soils in this Polebar-Millsholm-Gullied land complex are used the same as the individual soils that make up the complex. Capability unit VIIe–3.

Porterville Series

Soils of the Porterville series are nearly level to sloping and are well drained. They formed in alluvium from basic igneous and metamorphic rocks, mainly pillow basalt and greenstone. These soils are on alluvial fans, and most areas are in the southwestern part of the county near the Colusa County line. The vegetation is annual grasses and trees, and blue oaks and Digger pines are the main kinds of trees. Elevation ranges from 1,000 to 1,500 feet. The average annual rainfall is 20 to 25 inches.

The surface layer, a dark reddish-brown clay, is slightly acid to neutral. It generally is 25 to 35 inches thick and overlies brown to yellowish-brown light clay or clay loam that is mildly alkaline and intermittently calcareous. Structure typically is granular in the uppermost 1 to 2 inches and coarse prismatic below. Deep cracks extend into the substratum. Porterville soils gen-

erally contain gravel, and the gravel increases in amount and size with increasing depth.

Most of the Porterville soils are used as early pasture and range for sheep or cattle. The stands of blue oaks and Digger pines have been cleared from some areas, and these are used for irrigated pasture or dryfarmed barley and hay.

Porterville clay, 0 to 2 percent slopes (PtA).—This soil is on alluvial fans in the southwestern part of the county. It is mostly under annual grasses and blue oaks, but Digger pines and thickets of brush are on some areas. The brush is mainly chamise and buckbrush.

Representative profile:

0 to 16 inches, dark-brown clay in the uppermost 1 to 2 inches; then dark reddish-brown, very hard clay that contains a few pebbles and is dark reddish brown and very firm when moist; granular structure in the uppermost 1 to 2 inches, and very coarse prismatic below; cracks 1 to 2 inches wide form when the soil dries; slightly acid to neutral.

16 to 27 inches, reddish-brown, very hard gravelly clay that is dark reddish brown and firm when moist; massive; neutral to mildly alkaline and intermittently calcareous in the lower part; lime is segregated in small, soft masses.

27 to 40 inches +, brown to yellowish-brown, hard gravelly sandy clay loam that is dark brown and firm when moist; massive; neutral to mildly alkaline and intermittently calcareous; lime is segregated in small, soft masses.

The color of the surface layer ranges from dark brown to reddish brown or dark reddish brown, and that of the subsoil, from brown to dark brown or yellowish brown. The soil becomes more alkaline with increasing depth. It ranges from slightly acid to neutral in the surface layer, and from neutral to mildly alkaline in the subsoil. Lime generally is present in the lower part of the profile. A few areas are calcareous throughout. Gravel makes up 5 to 20 percent of the surface layer and 35 to 65 percent of the subsoil. It consists mainly of angular fragments of pillow basalt or greenstone. This soil generally is less gravelly in the nearly level areas at the outer edges of the fans than in other areas.

Permeability of this soil is slow. Runoff is slow, and the erosion hazard is slight. The available water holding capacity is 6 to 9 inches. Root penetration is deep, and fertility is moderate.

Included with this soil is a small area of dark grayish-brown to dark-gray soil. The area is around a natural artesian spring.

This Porterville soil is used chiefly for grazing sheep and cattle. Dryfarmed areas are used for barley, and yields are fair. In areas where irrigation water is available, this soil is used for pasture. Capability unit IIIs–5.

Porterville clay, 2 to 10 percent slopes (PtB).—This soil is more gravelly than Porterville clay, 0 to 2 percent slopes. Runoff is slow to medium, and the erosion hazard is slight to moderate. In a few areas incised drainageways 5 to 10 feet deep are in the upper parts of the fans. The content of gravel ranges from 10 to 25 percent in the surface layer, and from 40 to 65 percent in the subsoil.

All of this soil is used for grazing sheep and cattle. Areas cleared of blue oaks, Digger pines, and brush could be dryfarmed to barley, and if irrigation water were available, the soil would be fairly well suited to irrigated pasture. Capability unit IIIe–5.

Redding Series

In the Redding series are nearly level to gently sloping, well-drained, gravelly soils that have a hardpan. These soils formed in poorly sorted, old, gravelly and cobbly alluvium derived from sedimentary and metamorphic rocks of the Coast Ranges. They are on high terraces. The terraces are not much eroded or dissected by streams, and the surface has a distinct hummocky microrelief. Redding soils are west of Orland, and near Elk Creek and Newville. Elevation ranges from about 200 to 1,200 feet. The average annual precipitation ranges from about 15 to 25 inches. The vegetation is annual grasses and forbs.

The surface layer, a yellowish-red or reddish-brown gravelly loam, is medium acid to strongly acid. It overlies reddish-brown, dense clay or gravelly clay that rests abruptly on a similarly colored, strongly cemented, gravelly hardpan.

These soils are associated chiefly with the Corning and Newville soils. They are similar to those soils and in many places are adjacent to them. In contrast to the Redding soils however, Corning soils lack a cemented hardpan. Redding soils are not so brown as the Newville soils, which occupy slopes on dissected terraces and also lack a hardpan, but they are more acid than those soils.

Redding soils are used chiefly as early range for sheep and cattle, but some areas are dryfarmed to barley in rotation with pasture.

Redding gravelly loam, 0 to 3 percent slopes (Rg).—This is the only Redding soil mapped in the county. The surface has a hummocky microrelief. In the more nearly level areas, some of the small swales between the hummocks are intermittently ponded during the rainy season. Except in a few cultivated areas, the vegetation consists of annual grasses and forbs.

Representative profile:

0 to 14 inches, yellowish-red, hard gravelly loam that is yellowish red and friable to firm when moist; the gravel is mainly quartzite and chert; massive; medium acid, but strongly acid with increasing depth.

14 to 23 inches, reddish-brown, extremely hard, slightly gravelly clay that is dark yellowish red and extremely firm when moist; prismatic structure in the uppermost 3 to 4 inches, but blocky structure with increasing depth; medium acid; abrupt boundary.

23 to 36 inches +, yellowish-red, indurated gravelly hardpan that is cemented with iron and silica; massive; very slightly acid; at a depth below 36 inches grades to mottled, yellowish-red and light yellowish-brown, gravelly material that is weakly cemented, and with increasing depth becomes less consolidated and neutral in reaction.

The surface layer ranges from yellowish-red to reddish-brown or strong-brown gravelly loam. It is slightly acid to strongly acid and is 20 to 30 percent gravel, by volume. Cobblestones have accumulated in the surface layer in a few places in the swales. The subsoil generally is redder than the surface layer. It is reddish-brown or yellowish-red to red clay or gravelly clay that is medium acid to strongly acid. The subsoil is about 10 to 25 percent gravel, by volume. In some places cobblestones are in the lower part of the surface soil and in the upper part of the claypan.

In many places the prisms in the upper part of the subsoil have thin cappings of bleached material. Depth to the hardpan ranges from about 20 to 30 inches. The

hardpan generally is continuous; a few breaks occur in small included areas of Corning soils. The amount of gravel and cobblestones in the stratum below the hardpan varies considerably.

This soil generally is well drained, but runoff is slow to very slow. During the rainy season the surface soil becomes saturated for short periods and ephemeral pools form in many swales. These pools dry up only through evaporation. The surface soil is moderately permeable, and the subsoil is very slowly permeable. The upper part of the hardpan is impermeable, though water passes very slowly through the narrow joints or fissures. Erosion is slight or is not a hazard. The available water holding capacity is 3 to 4 inches. Fertility is low.

Redding gravelly loam is used mainly for range. In places, however, dryfarmed barley is grown in rotation with pasture. The forage on this soil consists mostly of filaree and other annual forbs and grasses. Fertilizing dryfarmed barley is not practical, because of the low available water capacity of the soil and the uncertainity of rain in spring. If irrigation water can be developed at low cost, sprinkler irrigated pastures produce a fair amount of forage. Capability unit IVs–8.

Riverwash

Riverwash (0 to 8 percent slopes) (Rh) consists of stratified deposits of sand and gravel. The areas are along drainageways, on sand and gravel bars of major active streams, and in the channels of intermittent creeks (fig. 7). The areas are periodically flooded each year and are subject to erosion and deposition.

Most areas of Riverwash have little vegetation of economic value on them, other than a few annual grasses and weeds that provide limited grazing. Open stands of willows, cottonwoods, black walnuts, tamarisk, and valley oaks cover most areas. Sand and gravel are mined in a few areas to provide construction material for buildings or roads. Capability unit VIIIw–4.

Figure 7.—**Areas of Riverwash along Stony Creek.**

Riz Series

The Riz series consists of poorly drained, fine-textured soils that are affected by excess salts and alkali. These soils formed in alluvium washed from sandstone, shale, and other sedimentary rocks. They are on the lower edges of old alluvial fans that border basin areas or are on alluvial fans that extend into basins. Riz soils generally are south of Willows at elevations of 90 to 150 feet. The vegetation is annual grasses and forbs and plants that tolerate salts and alkali. The average annual rainfall is 16 to 20 inches.

The surface layer of these soils is pale-brown, medium-textured or moderately fine textured material that is neutral or mildly alkaline. It is underlain by brown or yellowish-brown, fine-textured material that is moderately alkaline to very strongly alkaline and calcareous. The substratum, a light yellowish-brown, moderately fine-textured material, is alkaline to very strongly alkaline and is strongly calcareous. The soils are slightly to strongly affected by excess salts and alkali. They have a fluctuating high water table and are gleyed in the lower part of the profile.

These soils generally occupy areas between the poorly drained, fine-textured Willows soils, in basins, and the well-drained Myers and Hillgate soils, on alluvial fans.

The main crops grown on the Riz soils are rice and irrigated pasture. Dryfarmed areas are used for barley or range. Much of the acreage of the Riz soils is in the Sacramento National Wildlife Refuge. These areas provide food for wildlife or are flooded to provide areas for waterfowl.

Riz silty clay loam, strongly saline-alkali (0 to 1 percent slopes) (Rnc).—This soil is south of Willows on the lower edges of old alluvial fans that extend into basins. More than 50 percent of the surface area is slightly to strongly affected by excess salts and alkali.

Representative profile in an abandoned ricefield:

0 to 8 inches, pale-brown, hard silty clay loam that is light gray in the upper one-fourth inch and is dark brown and friable when moist; common, strong-brown mottles; the upper one-fourth inch has weak, platy structure, but the material below is massive; neutral.

8 to 34 inches, brown or yellowish-brown, very hard silty clay that is dark brown to dark yellowish brown and very firm when moist; weak, prismatic structure in the upper part but blocky structure in the lower part; moderately alkaline, but strongly alkaline to very strongly alkaline and calcareous with increasing depth; contains finely disseminated lime.

34 to 60 inches +, light yellowish-brown, hard silty clay loam and clay loam that are dark yellowish brown and firm when moist; common, dark manganese stains; massive; very strongly alkaline and strongly calcareous; lime is finely disseminated and also is segregated in soft, white masses; a few bluish-green gley spots.

The surface layer, a pale-brown, brown, or light grayish-brown silty clay loam or clay loam, is neutral to mildly alkaline. The number of strong-brown or reddish-brown mottles in the surface layer varies, depending on the past cropping history. The subsoil generally is brown or yellowish-brown silty clay or clay, but in places the color is strong brown. This layer is moderately alkaline to strongly alkaline in the upper part and strongly alkaline to very strongly alkaline and calcareous in the lower part. It is underlain by light yellowish-brown, yellowish-brown, or pale-yellow silty clay loam or clay

loam that is very strongly alkaline and calcareous. Bluish-green gley spots in the substratum vary in number, and in places they occur in the lower part of the subsoil.

Concentration of excess salts in this soil ranges from slight to strong, and the amount in the surface layer depends on the cropping history. Areas left idle for a few years develop a thin crust of salt or a puffy surface layer. The content of alkali or high exchangeable sodium varies within the profile, but it generally increases with increasing depth.

The soil is poorly drained and has a fluctuating high water table. The water table generally is at a depth of 2 to 5 feet and is highest during the summer growing season and during the rainy season. Permeability is very slow. Runoff is very slow, and erosion is slight or is not a hazard. The available water holding capacity is 9 to 11 inches. Fertility is moderate.

Riz silty clay loam, strongly saline-alkali, is used mainly for rice. Dryfarmed areas are used for barley or as pasture for sheep. Much of the acreage is in the Sacramento National Wildlife Refuge and is flooded to provide areas for waterfowl. Some areas are ponded and are used by private clubs for hunting ducks.

Rice levees in this soil are hard to maintain. They tend to slake away, especially when it is windy before rice seedlings emerge above the surface of the water. It is impractical to reclaim this soil, because of the high water table resulting from growing rice in the areas. Capability unit IVw–6.

Riz silty clay loam, moderately saline-alkali (0 to 1 percent slopes) (Rnb).—From 20 to 50 percent of the surface area of this soil is affected by excess salts and alkali.

This soil is used mainly for irrigated pasture and rice. A few areas are dryfarmed to barley or are used as range for sheep. Some areas are within the boundaries of the Sacramento National Wildlife Refuge and are flooded to provide refuge for waterfowl. Rice levees in this soil are likely to slake away, especially when it is windy before the rice seedlings emerge. Capability unit IIIw–6.

Riz silt loam, moderately saline-alkali (0 to 1 percent slopes) (Rmb).—The surface layer of this soil is not so fine textured, but this soil is otherwise similar to Riz silty clay loam, moderately saline-alkali.

Included with this soil are some Riz soils that have a surface layer of loam.

This Riz soil is used the same as Riz silty clay loam, moderately saline-alkali. Capability unit IIIw–6.

Riz silt loam, slightly saline-alkali (0 to 1 percent slopes) (Rma).—From 5 to 20 percent of the surface area of this soil is slightly to strongly affected by excess salts and alkali.

This soil is well suited to irrigated pasture and rice. Some areas are used for dryfarmed barley and safflower or as range for sheep. Except in the saline-alkali affected areas, yields are good. Capability unit IIIw–3.

Riz gravelly loam, moderately saline-alkali (0 to 1 percent slopes) (Rlb).—This soil occupies a few small areas along Hayes Hollow Creek and Salt Gulch. It is 10 to 25 percent gravel throughout the profile. Some areas are only slightly affected by excess salts and alkali.

This soil is associated with Hillgate gravelly loams and with Clear Lake clay.

All areas of Riz gravelly loam, moderately saline-alkali, are used for annual pasture in rotation with dryfarmed barley. If irrigation water were available, this soil would be suited to irrigated pasture. Capability unit IIIw–6.

Rock Land

Rock land consists of areas that have bedrock exposed over 50 to 90 percent of the surface area. These rock outcrops make cultivation or use of other farm machinery impractical, but the areas have limited value for range and timber. The areas were separated on the basis of the dominant kind of rock material.

Rock land, sedimentary rocks (15 to 70 percent slopes) (RosF) occupies small areas scattered throughout the western foothills and mountainous areas of the county. It is made up of outcrops of sandstone, conglomerate, or schistose sedimentary rocks. Except in small pockets and cracks between the rocks, the areas are nearly barren of soil material.

In the foothills the areas consist of massive outcroppings of conglomerate associated with the Millsholm and Contra Costa soils. Here the areas are mostly barren of vegetation, though grass and a few scattered blue oaks and shrubs grow in places. At higher elevations the areas consist of outcroppings of sandstone and schistose rocks associated with the Hugo, Maymen, and Sheetiron soils. Here the vegetation is sparse stands of canyon live oaks and a few shrubs.

Rock land, sedimentary rocks, is better suited to watershed, wildlife, and recreation than to other uses. It has little value for growing plants, other than those that provide limited grazing in areas in the foothills. Capability unit VIIIs–7.

Rock land, serpentine (15 to 70 percent slopes) (RouF) is outcrops of multifractured, greenish serpentine rock near areas of the Henneke and Dubakella soils. Except in cracks and crevices between the rocks, the areas are barren of soil material. The vegetation consists of sparse stands of shrubs and a few Digger pines.

Areas of Rock land, serpentine, have little value for growing plants. Constructing roads through the areas is risky, as the areas are subject to mass slippage. Capability unit VIIIs–9.

Rock land, volcanic rocks (10 to 70 percent slopes) (RovF) consists of rocky areas of basalt and metavolcanic rock (greenstone). The only soil material in the areas is in small pockets and cracks between the rocks.

Areas on basalt rock are associated with the Toomes soils. On these areas annual grasses grow in crevices between the rocks that are filled with soil material. The areas on greenstone are more extensive than those on basalt. Those that are associated with the Neuns soils support open stands of conifers and oaks, and those that are associated with the Goulding and Stonyford soils have a sparse cover of low shrubs and hardwoods on them.

Rock land, volcanic rocks, has little value for growing plants other than those that provide limited grazing in places. The areas are quite important for wildlife, watershed, and recreation and must be protected from wildfire. Capability unit VIIIs–7.

Rock Outcrop

Rock outcrop (10 to 70 percent slopes) (RpF) consists of areas that have rock outcrops over 90 percent of the surface area. The rocks are volcanic, metamorphic, or sedimentary and generally are similar to the parent material of the associated soils. Except for a few conifers, hardwoods, or shrubs, the areas are barren of vegetation.

Rock outcrop has no value for growing plants. Its use for wildlife, watershed, and recreation is limited. Capability unit VIIIs–7.

Sacramento Series

Soils of the Sacramento series are deep, dark colored, and somewhat poorly drained. They are nearly level and have a smooth surface. These soils formed in small basins in old alluvium deposited by the Sacramento River, and some areas are cut by sluggish drainageways. They are in the southeast corner of the county, east of the Sacramento River. Elevation is less than 100 feet. The average annual rainfall is about 18 inches. Annual grasses and forbs are the chief kinds of plants, but tules and cattails grow along the drainageways.

The surface layer is dark-gray clay that is somewhat mottled and is fairly thick. It overlies dark grayish-brown, thick clay that is distinctly mottled and becomes increasingly alkaline and somewhat lighter colored with increasing depth. The surface layer is slightly acid to mildly alkaline, and the layers below are mildly alkaline to moderately alkaline and calcareous.

These soils occupy areas within tracts of Marvin soils. They formed in similar parent material but occupy slightly lower positions and have poorer drainage. They are also grayer than the Marvin soils and lack a B horizon, which is typical of those soils.

Sacramento soils are used mainly for dryfarmed barley, but milo and safflower are grown on a few areas, and a small acreage is planted to rice. Livestock graze the barley stubble or volunteer forage when the soils are left idle.

Sacramento clay (0 to 2 percent slopes) (Sc).—This is the only Sacramento soil mapped in the county.

Representative profile:

0 to 18 inches, dark-gray, very hard clay that is very dark gray and firm to very firm when moist; granular structure but blocky with increasing depth; a few strong-brown mottles; slightly acid in the uppermost part but mildly alkaline with increasing depth.

18 to 44 inches, very dark grayish-brown, very hard clay that is similar in color and firm when moist; massive; a few, distinct, strong-brown mottles; fine, dark-colored pellets of iron and manganese; moderately alkaline and slightly calcareous; lime is segregated in small, soft masses.

44 to 60 inches +, dark grayish-brown, very hard clay that is very dark grayish brown and firm when moist; massive; a few olive-green mottles; fine, dark-colored pellets of iron and manganese; moderately alkaline and strongly calcareous; lime is finely disseminated and also segregated in small nodules.

The color varies little throughout, but mottling varies somewhat throughout the profile in number, size, and distinctness. The amount of lime varies from place to place.

This soil is very slowly permeable. Runoff is very slow, and in places the soil is ponded during the rainy season. Erosion is not a hazard. The available water holding capacity is 8 to 10 inches. Root penetration is deep.

Included with this soil are small areas of soils that are similar to Sacramento clay but are noncalcareous in the lower horizons.

Most areas of Sacramento clay are dryfarmed to barley and then pastured for 1 to 3 years. A small acreage is used for irrigated safflower and milo. If irrigation water were available at low cost, this soil would be well suited to rice and shallow-rooted field and forage crops. Capability unit IIIw–5.

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Sehorn Series

Soils of the Sehorn series are rolling to very steep, moderately deep, and well drained. These soils formed in material from noncalcareous sandstone and shale. They are in the foothills at elevations of 300 to 2,000 feet. The native vegetation was mostly annual grasses and forbs and blue oaks, but manzanita, buckbrush, and similar shrubs grew in a few places. The average annual precipitation is 18 to 25 inches.

The surface layer, a brown silty clay loam, clay loam, or light clay, is slightly acid. The subsoil is similar in color, but it is silty clay or clay and slightly acid to neutral. Depth to fractured sandstone and shale bedrock ranges from 20 to 40 inches. Rocks crop out in only a few places.

These soils are associated chiefly with soils of the Altamont, Contra Costa, and Millsholm series.

Sehorn soils are used for dryfarmed small grain and annual range. Deer are the principal wildlife. Water for livestock is obtained from farm ponds where runoff, which otherwise drains into the Sacramento River, is stored.

Sehorn soils, 30 to 65 percent slopes (SbE).—From 50 to 70 percent of this mapping unit is Sehorn clay, and 30 to 50 percent is Sehorn clay loam.

Representative profile:

0 to 5 inches, brown, hard clay loam that is dark brown and friable when moist; massive to subangular blocky structure; slightly acid.

5 to 27 inches, brown, hard clay that is dark brown and firm when moist; a few shale fragments are in the lower part; coarse, subangular blocky structure that is angular blocky with increasing depth; slightly acid to very slightly acid.

27 inches +, olive-gray, fractured shale or fine-grained sandstone; noncalcareous.

The surface layer is brown, light olive-brown, or pale-brown light clay, silty clay, silty clay loam, or clay loam near clay. Below is brown, light olive-brown, or yellowish-brown silty clay or clay. A few shale fragments are in the profile, and they generally are just above the parent rock. The profile is slightly acid to neutral throughout.

Depth to bedrock ranges from 20 to 40 inches, but in most places it is 25 to 34 inches. Rocks crop out in only a few places. Sehorn clay is similar to Sehorn clay loam, but the uppermost 5 inches of the surface layer is light clay.

Permeability is slow, runoff is rapid to very rapid, and the erosion hazard is severe to very severe. The available water holding capacity is 3 to 6 inches. Root penetration is moderately deep, and fertility is moderate.

Included with this soil are small areas of Altamont clay, Contra Coast clay loam, and Millsholm clay loam.

All areas of these Sehorn soils are used for annual range. They are too steep to cultivate. Capability unit VIe–5.

Sehorn soils, 3 to 15 percent slopes (SbC).—On these gently rolling soils, runoff is slow to medium and the erosion hazard is slight to moderate.

These soils are used for dryfarmed small grain, range, and wildlife. If water were available for sprinkler irrigation, irrigated field and forage crops could be grown. Capability unit IIIe–5.

Sehorn soils, 15 to 30 percent slopes (SbD).—On these hilly soils runoff is medium and the erosion hazard is moderate.

These soils are used chiefly for annual range and wildlife, but dryfarmed barley and other small grains are grown in some places. Capability unit IVe–5.

Sehorn-Gullied land complex, 10 to 30 percent slopes (ScD).—This complex consists of Sehorn soils that are cut by gullies but otherwise are similar to Sehorn soils, 15 to 30 percent slopes. The gullies are 2 to 5 feet deep and are at intervals of 500 to 1,000 feet.

This complex is used for dryfarmed grain, annual range, and wildlife. The gullies make the soils more difficult to cultivate than Sehorn soils, 15 to 30 percent slopes, and also make grazing more difficult. Under sprinkler irrigation some field and forage crops can be grown. Capability unit IVe–5.

Sehorn-Gullied land complex, 30 to 50 percent slopes (ScE).—This complex consists of Sehorn soils that are cut by gullies but are otherwise similar to Sehorn soils, 30 to 65 percent slopes. The gullies are 2 to 5 feet deep and are at intervals of 500 to 1,000 feet.

The soils in this complex are too steep for cultivation and are therefore used for range and wildlife. The gullies make grazing difficult. Capability unit VIe–5.

Sehorn-Millsholm association, 30 to 65 percent slopes (SdE).—From 50 to 60 percent of this mapping unit is Sehorn clay on 30 to 65 percent slopes, and from 40 to 50 percent is Millsholm clay loam on 30 to 65 percent slopes. The Sehorn soil is on north-facing slopes and toe slopes, and the Millsholm soil is on ridgetops and on south-facing slopes.

Included with this mapping unit are small areas of Altamont soils. This complex is used for range and wildlife. Capability unit VIe–5.

Sehorn-Millsholm association, 8 to 15 percent slopes (SdC).—This mapping unit occupies rolling areas, but it is otherwise similar to Sehorn-Millsholm association, 30 to 65 percent slopes.

All areas of this mapping unit are used for dryfarmed small grain, range, and wildlife. Capability unit IIIe–5.

Sehorn-Millsholm association, 15 to 30 percent slopes (SdD).—This mapping unit occupies hilly areas, but it is otherwise similar to Sehorn-Millsholm association, 30 to 65 percent slopes.

All areas of this mapping unit are used for dryfarmed small grain, range, and wildlife. Capability unit IVe–5.

Sehorn-Millsholm-Gullied land complex, 30 to 65 percent slopes (SeE).—This complex is cut by gullies, but it is otherwise similar to Sehorn-Millsholm association, 30 to 65 percent slopes. The gullies are 2 to 5 feet deep and are at intervals of 500 to 1,000 feet. Most of the gullies are in swales in the Sehorn soils.

All of this complex is used for range and wildlife. The gullies and steep slopes make it difficult for livestock to graze the areas. Capability unit VIIe–5.

Sehorn-Millsholm-Gullied land complex, 15 to 30 percent slopes (SeD).—This complex occupies rolling to hilly areas but otherwise is similar to Sehorn-Millsholm-Gullied land complex, 30 to 65 percent slopes. The areas are used for dryfarmed small grain, pasture, and range. They are also used for wildlife purposes. Capability unit IVe–5.

Shedd Series

The soils of the Shedd series are well drained and are calcareous. These soils formed in softly consolidated, nongravelly sediments of the Tehama formation. They are on smooth, undulating to steep foothills, mainly along the eastern edge of the foothills, from west of Willows to the Orland Buttes. The elevation ranges from 200 to 800 feet, and the average annual rainfall ranges from 16 to 20 inches. The vegetation is annual grasses and forbs.

These soils have a surface layer of light-gray or light brownish-gray silty clay loam. The subsoil is light-gray to pale-yellow silty clay loam. Below is light-gray to light olive-brown, softly consolidated sandstone and siltstone at a moderate depth. Throughout the profile, reaction is mildly alkaline to moderately alkaline and calcareous, and lime is both finely disseminated and segregated.

These soils are in the same general area and formed from parent material similar to that of the Altamont clay and of the Nacimiento soils. They also are associated in many places with the gravelly Newville soils, which formed in poorly sorted, gravelly deposits on slopes of terraces.

Most areas of the Shedd soils have been cultivated at some time. They are used chiefly for dryfarmed grain and as range for sheep or cattle.

Shedd silty clay loam, 3 to 15 percent slopes (SfC).—This moderately deep soil is on smooth, undulating to rolling foothills. It is mainly along the eastern edge of the foothills from west of Willows to the Orland Buttes.

Representative profile:

0 to 19 inches, light-gray, hard, heavy silty clay loam that is dark grayish brown and friable when moist; massive to subangular blocky structure, but in many places structure in the uppermost 1 to 3 inches is coarse platy; mildly alkaline to moderately alkaline and strongly calcareous; lime is both finely disseminated and segregated in small, hard concretions.

19 to 29 inches, pale-yellow, hard, heavy silty clay loam that is olive and friable when moist; massive; moderately alkaline and very strongly calcareous; lime is finely disseminated and also is segregated as mycelial lime and in small, hard concretions.

29 inches +, light-gray to olive, softly consolidated, weakly laminated, fine-grained sandstone and siltstone; a few brown to strong-brown mottles; moderately alkaline and calcareous; lime is concentrated mainly in thin seams or in pockets between thin layers.

The surface layer generally is light gray or light brownish gray, but it is grayish brown in places. The subsoil is similar in color or is lighter colored; it is

light gray, pale yellow, or light yellowish brown. Texture is dominantly silty clay loam, but in places it is clay loam or light silty clay. Reaction is mildly alkaline to moderately alkaline and calcareous throughout. Lime increases in amount with increasing depth. It ranges from 5 to 10 percent in the surface layer, and from 10 to 20 percent in the subsoil. Depth to softly consolidated, fine-grained sandstone and siltstone ranges from 20 to 40 inches, but it is dominantly 26 to 34 inches.

Permeability is moderately slow. Runoff is slow to medium, and the erosion hazard is slight to moderate. The available water holding capacity is 5 to 6 inches. Root penetration is deep. Fertility is high, but in places yields of some plants are limited by the high content of lime.

Included with this soil are small areas of Altamont clay soils in Altamont soils and of Nacimiento and Newville soils.

All of this Shedd soil has been cultivated at some time. The areas generally are dryfarmed to barley in rotation with pasture. The forage in the range consists chiefly of wild oats, soft chess, and burclover. If irrigation water were available, this soil could be sprinkler irrigated. Crops irrigated should be those that can tolerate a high lime content, because the excess lime in the soil causes iron chlorosis in some plants. Capability unit IIIe–5.

Shedd silty clay loam, 15 to 30 percent slopes (SfD).—On this soil runoff is medium and the erosion hazard is moderate.

This soil is used as pasture for sheep and cattle in rotation with dryfarmed grain. Use is otherwise the same as for Shedd silty clay loam, 3 to 15 percent slopes. If irrigation water were available, this soil could be sprinkler irrigated and many kinds of pasture plants and field crops could be grown. Capability unit IVe–5.

Shedd silty clay loam, 30 to 50 percent slopes (SfE).—This soil is along the south side of Stony Creek, west of the Orland Buttes. Runoff is rapid, and the erosion hazard is severe.

Included with this soil are small areas of shallow, eroded soils. Also included are small areas of Altamont clay and of Newville soils.

All of this Shedd soil is used as range for sheep and cattle. Livestock generally graze the areas on the contour because of the steepness of the slopes. The vegetation is chiefly annual grasses and forbs, but blue oaks grow in places. Capability unit VIe–5.

Shedd-Altamont association, 10 to 30 percent slopes (SgD).—From 50 to 80 percent of this mapping unit consists of Shedd silty clay loam, and the rest is Altamont clay. The Shedd soil, in convex areas on hilltops and side slopes, is similar to Shedd silty clay loam, 15 to 30 percent slopes. The Altamont soil, on convex toe slopes and in swales, is similar to the Altamont clay, 3 to 15 percent slopes.

Included with this mapping unit are small areas of gravelly Newville soils and of brown, calcareous Nacimiento soils.

This mapping unit is used mainly for range and dryfarmed grain or hay. Capability unit IVe–5.

Shedd-Altamont-Gullied land complex, 8 to 15 percent slopes (ShC).—Except that slopes are less steep and the areas are gullied, this mapping unit is similar to Shedd-Altamont association, 10 to 30 percent slopes. The gullies are 4 to 6 feet deep, are at intervals of 500 to 1,000 feet, and are in the Altamont clay soil. Runoff is medium, and the erosion hazard is moderate.

This mapping unit is used for dryfarmed barley. Cultivating and harvesting are therefore difficult and expensive. Sheep and cattle also have difficulty crossing the gullies and cannot graze so effectively as on nongullied range soils. Capability unit IIIe–5.

Sheetiron Series

The Sheetiron series consists of shallow or moderately deep, hilly to very steep soils that are well drained to somewhat excessively drained. These soils formed under coniferous forests in material from light-colored sericite schist and other related metamorphosed sedimentary rocks. Sheetiron soils are in the mountains in the western part of the county at elevations of 3,000 to 6,000 feet. The average annual precipitation is 30 to 55 inches.

These soils are gravelly and are medium in texture. The surface layer is thin, grayish brown, and medium acid, and the subsoil is pale brown or light yellowish brown and is medium acid to strongly acid. Structure is granular or is weak, subangular blocky. The soils are friable throughout.

Sheetiron soils are used mainly for timber. They are also used for wildlife, watershed, and recreational purposes.

Sheetiron gravelly loam, 30 to 50 percent slopes (SkE).—This moderately deep, well-drained soil is the most extensive timber soil in the county. It is widely scattered throughout the mountains and generally is at elevations of more than 3,000 feet.

Representative profile:

1½ inches to 0, fresh and partly decomposed litter made up of conifer needles and twigs.
0 to 3 inches, grayish-brown, soft gravelly loam that is dark grayish brown and very friable when moist; the gravel is mainly angular quartzite and fragments of schist and is less than one-half inch in diameter; the soil material feels like talc; granular structure; medium acid.
3 to 28 inches, light yellowish-brown, slightly hard gravelly loam that is olive brown and friable when moist; thin coatings of sericite around the pieces of gravel; weak, subangular blocky structure to massive; medium acid to strongly acid.
28 inches +, strongly folded and fractured sericite schist banded with quartzite seams; partly weathered in the upper part but is less fractured with increasing depth.

The surface layer ranges from 2 to 4 inches in thickness and from light brownish gray to dark grayish brown in color. In the subsoil the color ranges from pale brown to light yellowish brown. Reaction is slightly acid to medium acid in the surface layer and medium acid to strongly acid in the subsoil. Texture ranges from gravelly to very gravelly loam or light clay loam. The gravel generally increases in size and amount with increasing depth. Depth to parent rock ranges from 20 to 40 inches. Rocks crop out in only a few places.

This soil is well drained. Permeability is moderately rapid. Runoff is medium to rapid, and the erosion hazard is severe. The available moisture holding capacity is 3 to 5 inches.

Included with this soil are small areas of deep Jose-

phine soils at lower elevations and some Masterson soils that are at elevations of more than 5,000 feet. Also included are small areas of Maymen and Los Gatos soils.

Sheetiron gravelly loam, 30 to 50 percent slopes, is well suited to trees, and tree growth is moderate to moderately rapid. Nearly pure stands of ponderosa pine grow on south-facing slopes at the lower elevations, and mixed stands of Douglas-fir, ponderosa pine, sugar pine, white fir, and incense-cedar grow on north-facing slopes and at higher elevations. Christmas trees also grow on a few areas at higher elevations. This soil is also used for watershed, wildlife, and recreational purposes. Capability unit VIe–4.

Sheetiron gravelly loam, 10 to 30 percent slopes (SkD).—On this soil runoff is medium, and the erosion hazard is moderate. The areas are used the same as Sheetiron gravelly loam, 30 to 50 percent slopes. Capability unit IVe–4.

Sheetiron gravelly loam, 50 to 65 percent slopes (SkF).—South-facing slopes on this soil support open to semidense stands that consist mainly of ponderosa pines but that include some incense-cedars and black oaks. On the north-facing slopes are semidense to dense stands of various kinds of conifers and a few black oaks and low shrubs. Rocks crop out in only a few places. Runoff is rapid to very rapid, and the erosion hazard is very severe.

All of this soil is in timber, but the areas are also used for wildlife, watershed, and recreational purposes. In many places the upslope banks of roadcuts slump. Capability unit VIIe–4.

Sheetiron gravelly loam, shallow, 10 to 30 percent slopes (SlD).—This soil generally is on ridgetops under open stands of conifers that have an understory of manzanita. Depth to parent rock is 10 to 24 inches. Rocks crop out in only a few places. Runoff is medium, and the erosion hazard is moderate. The available moisture holding capacity is 3 to 4 inches.

This soil is used mainly for timber, but the areas are also used for wildlife, watershed, and recreational purposes. Capability unit VIe–4.

Sheetiron gravelly loam, shallow, 10 to 30 percent slopes, eroded (SlD2).—Most areas of this soil are along rather narrow ridgetops that formerly were used as driveways for moving cattle and sheep through the mountains. From 2 to 4 inches of the original surface layer of this soil has been lost through sheet erosion. Runoff is medium, and the erosion hazard is moderately severe. The available water holding capacity is 2 to 4 inches.

This soil is used the same as Sheetiron gravelly loam, shallow, 10 to 30 percent slopes. Capability unit VIe–4.

Sheetiron gravelly loam, shallow, 30 to 50 percent slopes (SlE).—In this soil depth to parent rock is 10 to 24 inches. The available moisture holding capacity is 3 to 4 inches. Runoff is rapid, and the erosion hazard is severe.

This soil is used about the same as Sheetiron gravelly loam, 30 to 50 percent slopes. Capability unit VIe–4.

Sheetiron gravelly loam, shallow, 30 to 50 percent slopes, eroded (SlE2).—From 2 to 4 inches of the original surface layer of this soil has been removed through sheet erosion. Depth to parent rock generally is 10 to 20 inches. Most areas of this soil are under open stands of various kinds of conifers and have an understory of shrubs. The available moisture holding capacity is 2 to 4 inches. Runoff is rapid, and the erosion hazard is severe.

This soil is used about the same as Sheetiron gravelly loam, 30 to 50 percent slopes. Capability unit VIe–4.

Sheetiron gravelly loam, shallow, 50 to 65 percent slopes (SlF).—In this soil depth to parent rock generally is 10 to 24 inches. The available water holding capacity is 3 to 4 inches. Runoff is very rapid, and the erosion hazard is severe.

This soil is used the same as Sheetiron gravelly loam, 50 to 65 percent slopes. Capability unit VIIe–4.

Sheetiron gravelly loam, shallow, 50 to 65 percent slopes, eroded (SlF2).—From 2 to 5 inches of the original surface layer of this soil has been removed through sheet erosion, but this soil is otherwise similar to Sheetiron gravelly loam, shallow, 50 to 65 percent slopes. Depth to parent rock generally is 10 to 20 inches. Rocks crop out in a few places. Runoff is very rapid, and the erosion hazard is severe. The available water holding capacity is 2 to 4 inches.

Semidense to dense stands of shrubs are on most areas of this soil, though sparse stands of conifers occupy a few areas. All areas of this soil are used for wildlife, watershed, and recreational purposes. Capability unit VIIe–4.

Stockton Series

The Stockton series consists of nearly level, somewhat poorly drained soils that formed in alluvium. The alluvium was from various kinds of rocks, but they were predominantly andesitic breccia from the hills bordering the east side of the Sacramento Valley. Stockton soils occupy basins west of Butte Creek. The native vegetation was annual grasses, forbs, and sedges, though valley oaks, willows, and cottonwoods grew along the banks of streams. Elevation ranges from 65 to 100 feet, and the average annual precipitation is 18 to 20 inches.

The surface layer, a very dark gray or black clay, is slightly acid to neutral. The subsoil is similar to the surface layer in color and texture but is mildly alkaline and slightly calcareous to moderately calcareous. It overlies a hardpan that is weakly cemented with lime and silica. Depth to the hardpan ranges from 30 to more than 60 inches.

These soils are associated mainly with soils of the Landlow series.

Stockton soils are used mainly for rice, but a small acreage is in irrigated pasture. Dryfarmed areas are used for barley, safflower, and range. Pheasant and waterfowl are the chief kinds of wildlife.

Stockton clay (0 to 1 percent slopes) (Sm).—This soil is in areas protected by levees in the basin between Butte Creek and local drainageways.

Representative profile:

0 to 25 inches, very dark gray, very hard clay that is black and firm when moist; coarse, subangular blocky structure; a few, faint mottles of strong brown; slightly acid to very slightly acid.

25 to 54 inches, very dark gray to very dark grayish-brown, very hard clay that is very dark gray to dark gray and firm when moist; massive; mildly alkaline and slightly

calcareous to moderately calcareous; lime is segregated in soft masses; a few mottles of strong brown.
54 to 65 inches +, light brownish-gray hardpan that is weakly cemented with lime and silica and is dark grayish brown when moist; moderately calcareous.

In color the surface layer ranges from very dark gray to black, and the subsoil ranges from very dark gray to grayish brown. Texture is clay throughout the profile. Depth to the hardpan generally is 36 to 60 inches, but in a few areas the hardpan is at a depth of less than 36 inches or it is lacking.

Permeability is slow above the hardpan and very slow in the hardpan. Runoff is very slow, and erosion is not a hazard. The available water holding capacity is 7 to 9 inches. Root penetration is deep. Fertility is moderate to high.

This soil is protected by levees and is used mainly for rice. Pasture plants, corn, milo, and other irrigated crops are also grown, and dryfarmed barley is grown in places. Pheasants and such waterfowl as ducks and geese are the principal kinds of wildlife. Capability unit IIIw–5.

Stockton clay, moderately deep (0 to 1 percent slopes) (Sn).—In this soil depth to the hardpan is 30 to 36 inches. The available water holding capacity is 5 to 7 inches. Use and management are the same as for Stockton clay. Capability unit IIIw–5.

Stockton clay, very deep (0 to 1 percent slopes) (So).—In this soil depth to the hardpan is more than 60 inches. Use is about the same as for Stockton clay. Capability unit IIIw–5.

Stockton clay, deep, overflow (0 to 3 percent slopes) (Sp).—All of this soil is within the levees that border creeks; it is flooded at least once a year. The areas have a dense cover of valley oaks, willows, and cottonwoods on them.

This soil is not suited to rice. It is used for pasture. Capability unit IVw–1.

Stockton clay, moderately deep, overflow (0 to 1 percent slopes) (Sr).—This soil is not protected by levees and is flooded at least once every 2 years. Most areas are used for irrigated pasture or are not irrigated and are used for range. A small acreage is used for milo and corn. Capability unit IVw–1.

Stockton clay, moderately deep, frequent overflow (0 to 5 percent slopes) (Ss).—This soil occupies old channels between levees that border creeks. It is subject to flooding several times each year.

This soil is used mainly for pasture or is left idle. It is not suitable for rice and other irrigated crops. Capability unit VIw–1.

Stonyford Series

In the Stonyford series are moderately steep to very steep, gravelly soils that are somewhat excessively drained and excessively drained. These soils are in mountainous areas on pillow basalt. The native vegetation was mainly chamise, ceanothus, manzanita, and chapparal oaks, though annual grasses grew in a few places. Elevation ranges from 1,200 to 3,500 feet, and the average annual precipitation is 25 to 40 inches.

The surface layer is brown to reddish-brown gravelly heavy loam. Below is reddish-brown gravelly clay loam. Depth to pillow basalt is 6 to 28 inches. The soils are slightly acid to neutral throughout.

These soils are associated chiefly with soils of the Henneke and Maymen series.

Stonyford soils are used chiefly for water supply and wildlife, but a small area, where the soil consists of clay, is also used for grazing.

Stonyford gravelly clay loam, 20 to 50 percent slopes (SuE).—This shallow soil is in mountainous areas.

Representative profile:

0 to 3 inches, brown, soft gravelly heavy loam that is dark reddish brown and very friable when moist; weak, subangular blocky to granular structure; slightly acid.
3 to 14 inches, reddish-brown, hard gravelly clay loam that is dark reddish brown and friable to firm when moist; subangular blocky structure; slightly acid.
14 inches +, brown to yellowish-brown, partly weathered and fractured pillow basalt.

The surface layer is brown, reddish-brown, or yellowish-red heavy loam or clay loam. Below is reddish-brown to dark reddish-brown sandy clay loam or clay loam. Reaction is slightly acid to neutral throughout. The content of gravel ranges from 20 to 45 percent, and the gravel increases in size and amount with increasing depth. Depth to basalt generally is 12 to 20 inches, but it ranges from 10 to 28 inches. Rock outcrops are common in places.

This soil is somewhat excessively drained. Permeability is moderate, runoff is medium to rapid, and the erosion hazard is severe. The available water holding capacity is 2 to 3 inches. Fertility is low, and root penetration is shallow.

Included with this soil are small areas of Henneke stony clay loams and of Maymen gravelly loams.

This Stonyford soil is used mainly for water supply and wildlife purposes. It also provides browse for livestock in some places. Deer are the principal wildlife. Capability unit VIIIs–8.

Stonyford gravelly clay loam, 20 to 50 percent slopes, eroded (SuE2).—This very shallow soil is less than 12 inches deep to bedrock. Drainage is excessive. Runoff is very rapid, and the erosion hazard is very severe. The available water holding capacity is 1 to 2 inches.

This soil is used mainly for water supply and wildlife purposes. It also provides limited browse for livestock. Capability unit VIIIs–8.

Stonyford gravelly clay loam, 50 to 65 percent slopes (SuF).—This soil is shallow to parent rock. Runoff is very rapid, and the erosion hazard is very severe.

This soil is used mainly for water supply and wildlife purposes. In places it also provides limited browse for livestock. Capability unit VIIIs–8.

Stonyford gravelly clay loam, 50 to 65 percent slopes, eroded (SuF2).—This very shallow soil is less than 12 inches deep to bedrock. Drainage is excessive. Runoff is very rapid, and the erosion hazard is very severe. The water-holding capacity is 1 to 2 inches.

The soil is used mainly for water supply and wildlife purposes. In places it also provides limited browse for livestock. Capability unit VIIIs–8.

Stonyford clay, 30 to 65 percent slopes (StE).—This soil is light clay throughout. The surface layer is grayish brown to brown, and the subsoil is dark brown to dark yellowish brown. The soil is neutral in reaction. Depth to basalt bedrock is 15 to 25 inches. The vegetation is mainly

blue oaks, annual grasses, scrub oaks, mountain-mahogany, and manzanita, but Digger pines grow in a few places.

This soil is somewhat excessively drained. Permeability is slow. Runoff is rapid to very rapid, and the erosion hazard is severe to very severe. Fertility is low to moderate, and the available water holding capacity is 3 to 4 inches. Root penetration is shallow to moderately deep.

All areas of this soil are used for annual range, water supply, and wildlife. Capability unit VIIe–5.

Stonyford-Henneke complex, 30 to 65 percent slopes (SvE).—From 40 to 60 percent of this complex is Stonyford gravelly clay loam, 50 to 65 percent slopes, eroded, and the rest is Henneke stony clay loam, 30 to 65 percent slopes. In places rock outcrops are common.

This complex is used for watershed areas and wildlife habitats. In places it also provides limited browse for livestock. Capability unit VIIIs–8.

Sunnyvale Series

In the Sunnyvale series are nearly level, dark-colored soils that are poorly drained and calcareous. These soils formed in alluvium derived chiefly from sedimentary and metasedimentary rocks. They are in basins in the eastern part of the county in the district of Bayliss. The vegetation is annual grasses and forbs and plants that tolerate wetness. Elevation ranges from 80 to 150 feet, and the average rainfall is 16 to 18 inches.

The surface layer, a very dark gray to black, calcareous clay, overlies light-gray to nearly white, extremely calcareous clay loam or clay at a depth of 15 to 25 inches. Below is mottled light olive-brown, light brownish-gray, and light yellowish-brown, calcareous clay loam that is less calcareous and less gleyed with increasing depth. The water table is at a depth of 30 to 36 inches throughout most of the year.

These soils are associated chiefly with soils of the Castro, Plaza, and Willows series.

Nearly all areas of the Sunnyvale soils are irrigated. The main crops are rice, milo, field corn, pasture plants, and alfalfa.

Sunnyvale clay (Sw).—This soil is in basins in the district of Bayliss. Slopes are less than 1 percent.

Representative profile:

0 to 24 inches, very dark gray, very hard clay that is black and firm when moist; the uppermost 1 inch has fine granular structure, but the material below has very coarse prismatic primary structure and subangular blocky secondary structure; mildly alkaline to moderately alkaline; slightly calcareous but is extremely calcareous with increasing depth; in the lower part lime is finely disseminated and also is segregated in fine, soft masses.

24 to 34 inches, light-gray, hard heavy clay loam that is dark grayish brown and friable when moist; massive; moderately alkaline and extremely calcareous; lime is finely disseminated and also is segregated in firm nodules.

34 to 60 inches +, light brownish-gray hard clay loam that is mottled light olive brown and light yellowish brown with increasing depth and is dark grayish brown, olive brown, and yellowish brown and firm when moist; massive; moderately alkaline but becomes slightly alkaline with increasing depth; strongly calcareous to slightly calcareous in the lower part; a few olive-green gley spots.

The surface layer is very dark gray or black, but in a few places it is dark gray. It is silty clay or clay that ranges from neutral to mildly alkaline and from slightly calcareous or noncalcareous in the upper 8 to 10 inches to moderately alkaline and strongly calcareous to extremely calcareous below that depth. The layer of lime accumulation is gray, light-gray, or white clay loam or clay that is moderately alkaline and extremely calcareous. The substratum is silty clay loam, clay loam, or light clay and is less alkaline but slightly calcareous with increasing depth. It is mottled, and the colors range from light brownish gray, light olive brown, or light gray to light yellowish brown. Gleying is common. The water table generally is at the same depth as the substratum. This soil is free of excess salts and alkali.

The water table is at a depth of 2 to 4 feet, and it generally is highest during the ricegrowing season. Permeability is slow. Runoff is very slow and erosion is not a hazard. Fertility is moderate to high. Root penetration is moderately deep to deep. The available moisture holding capacity is 9 to 11 inches.

Included with this soil are some Castro soils that have a caliche layer and some Willows soils that have a dense subsoil. These included soils make up as much as 20 percent of some areas.

The principal irrigated crops grown on this Sunnyvale soil are rice (fig. 8) and pasture plants. Other irrigated crops are milo, corn, ladino clover, and sudangrass, though alfalfa grows in some places. In a few places dryfarmed barley and safflower are rotated with irrigated crops. Capability unit IIIw–5.

Sunnyvale silty clay, slightly saline-alkali (0 to 1 percent slopes) (Sxa).—From 5 to 20 percent of the surface area of this soil is slightly to strongly affected by salts and alkali, and the surface layer is slightly less fine textured, but this soil is otherwise similar to Sunnyvale clay.

This soil is used and managed about the same as Sunnyvale clay. Applying soil amendments, such as iron sulfate, to the saline-alkali affected areas helps to in-

Figure 8.—Seeding rice by airplane in Sunnyvale clay.

crease yields of rice and other crops. Capability unit IIIw–5.

Sunnyvale silty clay loam (0 to 1 percent slopes) (Sy).—Areas of this soil are between the Plaza soils and Sunnyvale clay. The surface layer generally is gray or dark-gray silty clay loam and ordinarily is noncalcareous. This soil has less lime in the subsoil than Sunnyvale clay.

On this soil the chief irrigated crops are pasture plants, ladino clover, and rice. Minor irrigated crops include milo, field corn, alfalfa, and sudangrass. In a few places dryfarmed barley and safflower are grown in rotation with rice. Capability unit IIIw–3.

Tehama Series

Soils of the Tehama series are nearly level to sloping and are well drained. These soils formed in alluvium primarily from schistose and sedimentary rock. They are on old alluvial fans and low terraces. The native vegetation was chiefly annual grasses and forbs, but a few blue oaks grew in some areas in the foothill valleys. Elevation ranges from 100 to 1,000 feet, and the average annual precipitation is 16 to 20 inches.

The surface layer is pale brown, medium textured, and medium acid, and in places it is gravelly. The subsoil, a brown light silty clay loam or heavy silty clay loam, is slightly acid to neutral. Below is pale-brown, pale-yellow, and light-gray silty clay loam that is mildly alkaline to moderately alkaline and is intermittently calcareous.

These soils are associated chiefly with soils of the Arbuckle, Hillgate, and Plaza series.

Tehama soils are used for many irrigated row, field, pasture, and tree crops. Dryfarmed areas are used for small grain and annual range. The wildlife in the areas is mostly small game birds.

Tehama silt loam, 0 to 3 percent slopes (Tm).—This deep soil is on low terraces. It is the most extensive soil in the northeastern part of the county.

Representative profile:

0 to 12 inches, pale-brown, hard silt loam that is brown and friable when moist; massive; medium acid.

12 to 27 inches, brown, hard to very hard silty clay loam to heavy silty clay loam that is dark brown and very firm when moist; angular to subangular blocky structure; slightly acid to mildly alkaline.

27 to 60 inches +, pale-brown, pale-yellow, and light-gray, hard silty clay loam that is brown, yellowish brown and grayish brown and firm when moist; subangular blocky structure to massive; mildly alkaline to moderately alkaline and slightly calcareous to moderately calcareous; in lower part lime is both finely disseminated and segregated in soft masses.

The surface layer ranges from pale-brown to light grayish-brown or brown loam to silt loam. It is slightly gravelly in a few places. Below is brown, light yellowish-brown, light-brown, to brownish-yellow silty clay loam to heavy clay loam. Lime is intermittently present at a depth below 30 inches.

Permeability is slow, runoff is very slow, and the erosion hazard is slight. The available water holding capacity is 8 to 10 inches. Root penetration is deep, and fertility is moderate.

Included with this soil are small areas of Arbuckle gravelly loams, of Hillgate loams, and of Plaza silt loam.

This Tehama soil is used for irrigated pasture, ladino clover, alfalfa, corn, sorghum, almonds, oranges, olives, and rice. Dryfarmed areas are used for small grain, pasture, and range. The surface of this soil is likely to seal over when the soil is irrigated and hinder penetration of water. In many irrigated pastures the surface layer is compacted as the result of pasturing the soils too soon after an irrigation. Pheasants and doves, in limited numbers, are the chief kinds of wildlife. Capability unit IIs–3.

Tehama loam, deep to gravel, 0 to 3 percent slopes (Tb).—In this soil gravel and sand are at a depth below 40 to 50 inches. The profile contains from 5 to 10 percent gravel, by volume. The available water holding capacity is 6 to 8 inches.

This soil is used for the same crops as Tehama silt loam, 0 to 3 percent slopes. Capability unit IIs–3.

Tehama loam, moderately deep over gravel, 0 to 2 percent slopes (Tg).—In this soil gravel and sand are at a depth below 20 to 35 inches. This soil occupies narrow stringers near Cortina soils. The available water holding capacity is 4 to 5 inches.

Areas of this soil are too narrow to be farmed separately. They are used mostly for irrigated pasture or dryfarmed barley, or are left idle and pastured. Capability unit IIIw–0.

Tehama clay loam, 0 to 2 percent slopes (TcA).—The surface layer of this soil is finer textured than that of Tehama silt loam, 0 to 3 percent slopes, but otherwise the two soils are similar. The available water holding capacity is 9 to 11 inches.

This soil is used in about the same way as Tehama silt loam, 0 to 3 percent slopes. Capability unit IIs–3.

Tehama clay loam, 2 to 10 percent slopes (TcB).—This soil is in narrow valleys in the foothills. Runoff is slow to medium, and the erosion hazard is slight to moderate. A few areas have deep gullies.

This soil is used mostly for dryfarmed small grain and annual range. A source of irrigation water is not now available. Capability unit IIe–3.

Tehama fine sandy loam, 0 to 3 percent slopes (Tf).—This soil occupies areas between Jacinto fine sandy loams and Tehama silt loam, 0 to 3 percent slopes. It has a subsoil of clay loam. The available water holding capacity is 8 to 10 inches.

Most areas of this soil are used for dryfarmed small grain, pasture, and range. Some areas are irrigated, and these are used for pasture, ladino clover, sorghum, almonds, and olives. Capability unit IIs–3.

Tehama gravelly loam, 0 to 3 percent slopes (Tg).—In this soil the surface layer is 15 to 30 percent gravel. The subsoil, a gravelly clay loam, is 10 to 25 percent gravel. The available water holding capacity is 6 to 8 inches.

This soil is used about the same as Tehama silt loam, 0 to 3 percent slopes. Capability unit IIs–4.

Tehama gravelly loam, moderately deep over hardpan, 0 to 2 percent slopes (Th).—This soil overlies an indurated hardpan that is cemented with silica and is at a depth of 30 to 36 inches. The available water holding capacity is 4 to 5 inches.

All of this soil is used for dryfarmed small grain and annual range. If irrigation water were available, this

soil would be well suited to shallow-rooted field and forage crops. Capability unit IIIs–3.

Tehama gravelly fine sandy loam, moderately deep over gravel, 0 to 2 percent slopes (Tk).—The surface layer of this soil is 15 to 30 percent gravel. The subsoil, a gravelly clay loam, is 10 to 25 percent gravel. Gravel and sand are at a depth below 30 to 40 inches. The available water holding capacity is 4 to 5 inches.

This soil is used for dryfarmed small grain and annual range. If irrigation water were available, this soil could be used for many field and forage crops and for some tree crops. Capability unit IIIs–4.

Tehama silt loam, water table, 0 to 2 percent slopes (Tn).—This soil is in valleys along narrow stream drainageways. It has an intermittent water table at a depth of 3 to 4 feet during the rainy season. The water table rises and falls as the stream rises and falls. It is at a depth below 5 feet in the growing season if no water is turned down the drainageways.

This soil is used about the same as Tehama silt loam, 0 to 3 percent slopes. Under irrigation deep-rooted perennial crops, such as alfalfa or orchards, are not well suited to this soil because of the intermittent high water table. This soil is well suited to shallow and moderately deep rooted field and forage crops, which are not affected by the water table. Capability unit IIIw–3.

Tehama-Gullied land complex, 2 to 10 percent slopes (ToB).—This complex consists of Tehama clay loam, 2 to 10 percent slopes, that is cut by a few gullies. The gullies are 5 to 8 feet deep and cut through the middle of the areas. Runoff is slight to medium, and the erosion hazard is slight to moderate.

Most of this soil is used for annual range. A few areas are used for dryfarmed small grain. Capability unit IIe–3.

Terrace Escarpments

Terrace escarpments (30 to 70 percent slopes) (TpF) occupies steep to very steep breaks between terraces at different levels or is on steeply sloping side walls along drainageways that dissect the areas. Most areas are along major streams, where the streams enter the valleys and foothills between Elk Creek and Newville. The vegetation is annual grasses and forbs, but some areas also have open stands of blue oak and common manzanita on them.

The material in this land type is variable. On the upper part of the escarpment, the soil material generally is unconsolidated gravelly material of the Corning, Hillgate, Newville, Perkins, or Redding series. On the lower slopes along the base of the escarpment, the soil material is a mixture of material from areas above and of outcroppings of sandstone, shale, or other rock.

Terrace escarpments has little value for farming. The areas are too steep for tillage, but in places they produce forage for limited grazing. Capability unit VIIe–3.

Toomes Series

In the Toomes series are gently sloping to moderately steep, well-drained soils that formed in material from basic volcanic rock. The rock is basalt that is free of olivine. Toomes soils are on lava flows, primarily in the Orland Buttes area, that cap sedimentary rock of the Cretaceous period. They are under annual grasses and forbs at elevations of 300 to 1,000 feet. The average annual precipitation is 18 to 20 inches.

These soils are shallow and are very rocky or extremely rocky. They are brown, medium textured, and medium acid to strongly acid throughout. Depth to basalt varies greatly within a short distance; it ranges from a few inches to more than 24 inches.

Toomes soils are associated chiefly with the Burris soils, on colluvial slopes, and with the Altamont soils, on sandstone and shale.

All areas of these soils are used for annual range. Use of these soils for watershed areas is limited.

Toomes extremely rocky silt loam, 5 to 30 percent slopes (TsC).—This soil is on rocky slopes. Rock outcrops occupy from 25 to 50 percent of the surface area.

Representative profile:

0 to 16 inches, brown, slightly hard gravelly to very gravelly silt loam that is very dark grayish brown and friable when moist; massive to weak, subangular blocky structure; medium acid to strongly acid throughout.

16 inches +, dark-gray columnar basalt; soil material and roots are in the cracks between the rocks.

Depth of this soil varies greatly within a short distance. It ranges from a few inches to more than 2 feet, but it generally is 8 to 20 inches in depth. Texture is loam or silt loam. Gravel makes up 35 to 70 percent of the soil mass and increases in size and amount with increasing depth. The soil is medium acid to strongly acid throughout. Rock outcrops occupy 25 to 50 percent of the surface area.

Permeability is moderate. Runoff is slow to medium, and the erosion hazard is slight to moderate. Root penetration is very shallow to shallow, and the available water holding capacity is 1 to 3 inches. Fertility is fair.

Included with this soil are small areas of basaltic rock land.

This Toomes soil is too rocky for cultivation. All areas are used for range. The forage is mainly soft chess, wild oats, annual fescue, filaree, and other annual grasses and forbs. Capability unit VIIs–7.

Toomes very rocky silt loam, 10 to 30 percent slopes (TrD).—This soil is underlain by basalt and is on side slopes of the flow. Rock outcrops make up 10 to 25 percent of the surface area. Depth to basalt generally is 10 to 25 inches. Runoff is slow to medium, and the erosion hazard is slight to moderate. The available moisture holding capacity is 2 to 3 inches.

This soil is too rocky for cultivation. All areas are used for annual range. The forage on the range is similar to that on Toomes extremely rocky silt loam, 5 to 30 percent slopes. Capability unit VIIs–7.

Tyson Series

In the Tyson series are shallow to deep, moderately steep to very steep soils that are well drained. These soils formed in material from metamorphosed sedimentary rock. The rock consists mainly of partly metamorphosed sandstone and shale or is sericite schist that has seams of quartzite. Tyson soils are in mountainous areas in the western part of the county. Elevations range from 2,000 to 5,000 feet. Rainfall increases rapidly with in-

creasing elevation and ranges from 30 to 55 inches annually. The vegetation in most areas is shrubs or shrubs and grasses.

The surface layer is dark grayish-brown, very friable gravelly loam that is slightly acid to medium acid. Below is pale-brown or brown gravelly loam that is medium acid. Depth to bedrock ranges from 15 to 30 inches

At lower elevations Tyson soils are associated chiefly with soils of the Los Gatos and Maymen series. At higher elevations they are associated chiefly with the Hulls and Sheetiron soils.

Tyson soils are used primarily as watershed areas and wildlife habitats. A few areas under grass are used for summer range.

Tyson gravelly loam, 30 to 50 percent slopes (TtE).—This shallow soil is mostly under dense stands of shrubs or of shrubs and grasses.

Representative profile:

0 to 5 inches, dark grayish-brown, soft gravelly loam that is very dark grayish brown and very friable when moist; feels like talc; granular structure; slightly acid to medium acid.

5 to 23 inches, brown to pale-brown, slightly hard gravelly loam to heavy loam that is dark brown or brown and friable when moist; feels like talc; gravel has a thin coating of sericite; subangular blocky structure but massive with increasing depth; medium acid.

23 inches +, strongly folded and fractured sericite schist that has thin seams of whitish quartzite.

The surface layer is grayish-brown or dark grayish-brown gravelly or very gravelly loam. The subsoil is pale-brown, brown, or light yellowish-brown gravelly or very gravelly loam or heavy loam. Gravel makes up 30 to 65 percent of the soil mass, and in places the gravel content increases slightly with increasing depth. The surface layer is slightly acid to medium acid. The subsoil generally is medium acid but in a few places it is strongly acid. Depth to fractured parent rock ranges from 15 to 30 inches but is dominantly 18 to 24 inches. Rocks crop out in a few places.

This soil is well drained. Permeability is moderately rapid. Runoff is rapid, and the erosion hazard is severe. Root penetration is shallow to moderately deep, and fertility is moderate. The available water holding capacity is 3 to 4 inches.

Included with this soil are some shallow, eroded soils and small areas of Hulls, Los Gatos, Maymen, and Sheetiron soils.

The vegetation on this Tyson soil is mainly semidense to dense stands of various kinds of shrubs and a sparse understory of annual grasses. A few Digger pines grow in some areas. The shrubs are mainly Brewer oak, scrubby interior live oak, California scrub oak, mountainmahogany, and Eastwood manzanita. The grasses are mainly annual brome and fescue growing along with various kinds of forbs.

The shrubs and grasses on this soil protect the watershed and provide browse and cover for wildlife. In summer the shrubs also provide some browse for livestock, and the sparse cover of grasses provides forage for the livestock. Capability unit VIIe–8.

Tyson gravelly loam, shallow, 30 to 50 percent slopes, eroded (TvE2).—This soil is moderately eroded. Except around the base of shrubs, most of the original surface layer has been removed through sheet erosion. In a few areas rill erosion and shallow gullies are present. Depth to parent rock generally is 12 to 18 inches. Rocks crop out in a few areas.

The vegetation on this soil is chiefly semidense stands of various kinds of shrubs, but Digger pines grow in a few places. All of this soil is used for watershed areas and wildlife habitats. Capability unit VIIIs–8.

Tyson gravelly loam, shallow, 50 to 65 percent slopes, eroded (TvF2).—On this soil runoff is very rapid and the erosion hazard is very severe.

The vegetation on this soil is similar to that on Tyson gravelly loam, shallow, 30 to 50 percent slopes, eroded, and use is similar. Capability unit VIIIs–8.

Tyson gravelly loam, deep, 10 to 30 percent slopes (TuD).—This soil is mostly near Mendocino Pass in the northwest corner of the county. The surface layer is medium acid, and the subsoil is medium acid to strongly acid. Depth to bedrock is predominantly 30 to 50 inches. Runoff is slow to medium, and the erosion hazard is moderate. The available water holding capacity is 4 to 6 inches. Included are small areas of Hulls soils.

The vegetation on this Tyson soil is mainly annual grasses and bracken ferns. It provides forage for livestock in summer and also provides food for deer and other wildlife. The areas are also used for watershed and water supply purposes. Capability unit VIe–8.

Tyson gravelly loam, deep, 30 to 50 percent slopes (TuE).—On this soil runoff is rapid, and the erosion hazard is severe.

Included with this soil are small areas of Hulls gravelly loams and of shallow Tyson soils.

The vegetation on this Tyson soil is similar to that on Tyson gravelly loam, deep, 10 to 30 percent slopes. Use is similar. Capability unit VIe–8.

Willows Series

In the Willows series are nearly level, poorly drained soils that are affected by excess salts and alkali. These soils formed in fine-textured alluvium derived mainly from sedimentary rock from the foothills or from a mixture of sedimentary, metasedimentary, and metavolcanic rocks from the mountains. They are in basins under grasses and forbs that tolerate excess salts and alkali and tules, cattails, and sedges that tolerate wetness. Elevations range from 70 to 150 feet. The average annual rainfall is 15 to 18 inches.

The surface layer, a dark grayish-brown clay, is slightly acid to mildly alkaline. Below is dark-brown clay that is moderately alkaline and calcareous. The substratum is brown or yellowish-brown clay that is moderately alkaline to strongly alkaline and calcareous. It is somewhat mottled and gleyed in the lower part. The content of excess salts and alkali varies greatly within a short distance. The water table is high for much of the year. In places the substratum is weakly cemented with lime and silica.

These soils are associated chiefly with soils of the Capay, Myers, and Riz series, in the area south of Willows. They are also associated with the Castro soils and with the Plaza soils that have a dense subsoil, in the districts of Bayliss and Fairview.

Willows soils are used mostly for rice. Milo, safflower,

corn, and irrigated pasture are grown in a few areas. Some areas severely affected by excess salts and alkali are pastured. Others are flooded to provide refuge for waterfowl, and some are flooded and used by members of private clubs for hunting ducks.

Willows clay, moderately saline-alkali (0 to 1 percent slopes) (Wcb).—This soil is in basins south of Willows. Slopes are less than 1 percent. From 20 to 50 percent of the area is slightly to strongly affected by excess salts and high content of exchangeable sodium.

Representative profile:

0 to 23 inches, dark grayish-brown, very hard clay that is very dark grayish brown and very firm when moist; common, distinct mottles of strong brown; the uppermost one-half inch has granular structure, but the material below has very coarse, prismatic structure, of the kind characteristic of adobe soils, and angular blocky secondary structure; dense plowpan layer 9 to 13 inches thick; the uppermost 8 to 10 inches is slightly acid and the material below is mildly alkaline and is intermittently calcareous in the lower part.

23 to 34 inches, dark-brown, extremely hard clay that is dark brown and very firm when moist; a few, distinct mottles of strong brown; massive; moderately alkaline and slightly calcareous; lime is finely disseminated and also is segregated in soft, white masses; in places bluish-green gleying occurs along root channels; a few small pockets of gypsum crystals.

34 to 62 inches +, brown to yellowish-brown, very hard clay that is dark brown to dark yellowish brown and very firm when moist; a few, distinct mottles of strong brown and common, dark manganese stains; massive; moderately alkaline to strongly alkaline and slightly calcareous to strongly calcareous; lime is finely disseminated and also is segregated in soft, white masses; common to many, bluish-green gleyed spots; a few, small pockets of gypsum crystals; water table is at a depth of 60 inches.

The surface layer is dark grayish-brown or dark-brown silty clay or clay. It generally is slightly acid to neutral in the upper part and mildly alkaline to moderately alkaline and slightly calcareous to moderately calcareous in the lower part. In areas not used for rice for a few years, salts move upward in the profile and make the surface layer alkaline and more salty than typical. The subsoil, a brown or dark-brown silty clay or clay, is moderately alkaline to strongly alkaline and slightly calcareous to strongly calcareous. Below is brown, yellowish-brown, or light yellowish-brown silty clay, clay, or heavy clay loam that is moderately alkaline to strongly alkaline and slightly calcareous to strongly calcareous.

Rust mottles throughout the profile are quite variable, depending upon past cropping history. The degree of bluish-green gleying in the subsoil and substratum also is quite variable. Pockets of small gypsum crystals generally are in the subsoil and substratum but are lacking in some areas.

The concentration and distribution of salts throughout the profile is transitory and depends on present and past cropping history. Exchangeable sodium is less mobile than other salts and tends to be concentrated mainly in the lower horizons. It accounts for 15 to 60 percent of the cation-exchange capacity in saline-alkali affected areas.

Depth to the fluctuating water table in this soil ranges from 2 to 5 feet within the year. It generally is highest during the ricegrowing season and has a secondary high during the rainy season. Permeability is very slow. Runoff is very slow, and erosion is not a hazard. The available water holding capacity is 8 to 10 inches. Fertility is moderate.

Included with this soil are small areas of Riz soils and of other Willows soils.

Willows clay, moderately saline-alkali, is used chiefly for rice. Other irrigated crops are milo, corn, and pasture plants. In a few places rice is grown in rotation with dryfarmed barley and volunteer pasture. Some areas of this soil are within the Sacramento National Wildlife Refuge and are flooded for waterfowl areas or to provide food for wildlife. Some privately owned areas adjacent to the Refuge are also flooded and used by members of clubs for hunting ducks. Other areas provide habitats for pheasants. Capability unit IIIw–6.

Willows clay, slightly saline-alkali (0 to 1 percent slopes) (Wca).—This soil occupies a large acreage south of Willows. From 5 to 20 percent of the area is affected by excess salts and alkali.

Included with this soil are small areas of other Willows soils. Also included are small areas of Capay and Riz soils.

This Willows soil is used for the same crops as Willows clay, moderately saline-alkali, and management is similar. Yields generally are higher because a smaller area is affected by salts and alkali. Waterfowl and pheasant are the main kinds of wildlife and are hunted in fall and winter. Capability unit IIIw–5.

Willows clay, strongly saline-alkali (0 to 1 percent slopes) (Wcc).—This soil is mostly near Logandale, Norman, and Riz Siding. More than 50 percent of the area is affected by excess salts and high exchangeable sodium.

Rice is the chief crop grown on this soil. A moderate acreage is left idle, or the volunteer forage on it provides limited grazing. Other areas are within the Sacramento National Wildlife Refuge and are flooded for waterfowl. Some privately owned areas are flooded and used by members of clubs for hunting duck. Pheasants and waterfowl are the main kinds of wildlife; they are hunted in fall and winter. Capability unit IVw–6.

Willows clay, dense subsoil, slightly saline-alkali (0 to 1 percent slopes) (Wda).—This soil is in nearly level basins. The areas are mostly in the Larkins Childrens Rancho, southeast of Willows. This soil formed in alluvium derived mainly from various kinds of rock washed from mountainous areas in the western part of the county. It is grayer than Willows clay, moderately saline-alkali, and is less affected by salts and alkali. It also has a substratum that is weakly cemented by lime and silica. Depth to the substratum is moderate to deep.

Representative profile:

0 to 22 inches, gray, very hard clay that is very dark grayish brown and very firm when moist; the uppermost 9 inches is friable when moist; massive; a very dense plowpan is at a depth of 9 to 13 inches; a few to many, prominent, fine mottles of strong brown; a few, fine pellets of iron and manganese; slightly acid in the lower part.

22 to 35 inches, grayish-brown, very hard clay that is dark grayish brown and very firm when moist; massive; a few, prominent mottles of strong brown; moderately alkaline and slightly calcareous; lime is finely disseminated and also is segregated in small, soft, white masses.

35 to 46 inches, light brownish-gray, extremely hard clay loam that is weakly cemented with lime and silica and is dark grayish brown and very firm or brittle when moist; many, distinct mottles of light yellowish brown; a few,

bluish-green gleyed spots; the cementation decreases with increasing depth; strongly alkaline and slightly calcareous; lime is finely disseminated and also is segregated in soft masses and along walls of tubular pores.

46 to 56 inches +, light brownish-gray, very hard clay loam that is dark brownish gray and firm when moist; massive; a few, prominent mottles of light yellowish brown; common, bluish-green gleyed spots; strongly alkaline and slightly calcareous; lime is finely disseminated and also is segregated in soft, white masses and along walls of pores.

The surface layer ranges from gray or grayish brown to dark gray, and the material just below from light brownish gray to light olive brown or light yellowish brown. The dense subsoil varies in thickness, hardness, and degree of cementation within a short distance. Depth to this layer ranges from 24 to 45 inches, but it is dominantly 30 to 40 inches. The cemented layer hinders development of roots and movement of water. Texture is silty clay or clay in the surface soil and in the material just below. The material below the dense subsoil is clay loam, silty clay loam, or light clay.

Rust mottles in this soil and the degree of gleying depend on the past cropping history. Throughout the profile, salts and alkali vary in concentration and distribution. The salts are quite mobile and move upward and downward in the profile according to the crop grown. In areas under rice, leaching of salts is downward, but in areas fallowed; dryfarmed, or left idle, the salts move upward and into the surface soil. The water table is at a depth of 2 to 5 feet. It persists for most of the year and is highest during the ricegrowing season.

Included with this soil are small areas of other Willows soils that have a dense subsoil. Also included are small areas of Castro and Plaza soils.

This Willows soil is used mostly for rice and irrigated pasture. Small areas are in irrigated corn, milo, and sudangrass. In places in idle areas, volunteer forage plants provide grazing. Some areas are fallowed or left idle for a year and then are replanted to rice. Dryfarmed crops grown are mostly safflower and barley. Waterfowl and pheasant provide hunting in fall and winter. Capability unit IIIw–5.

Willows clay, dense subsoil (0 to 1 percent slopes) (Wd).—This soil is free of excess salts and alkali, but it is otherwise similar to Willows clay, dense subsoil, slightly saline-alkali. Use and management are also similar. Yields are somewhat higher because the areas are not affected by excess salts and alkali. Capability unit IIIw–5.

Willows clay, dense subsoil, moderately saline-alkali (0 to 1 percent slopes) (Wdb).—From 20 to 50 percent of the area of this soil is slightly to strongly affected by salts and by high exchangeable sodium, but this soil is otherwise similar to Willows clay, dense subsoil, slightly saline-alkali.

Rice and pasture plants are the main irrigated crops on this soil. In some areas left idle, volunteer annual weeds and plants that tolerate wetness provide forage for grazing. A few areas are flooded, and these provide areas where waterfowl are hunted. Pheasant are also hunted in some areas. Capability unit IIIw–6.

Willows clay, dense subsoil, strongly saline-alkali (0 to 1 percent slopes) (Wdc).—More than 50 percent of the area of this soil is affected by excess salts and alkali, but this soil is otherwise similar to Willows clay, dense subsoil, slightly saline-alkali.

Rice and irrigated pasture plants are the major irrigated crops on this soil. Many areas are left idle and grazed or are flooded and used as hunting areas for waterfowl. Pheasant are also hunted on this soil. Little can be done to improve this soil because it has a high water table. Capability unit IVw–6.

Wyo Series

The Wyo series consists of moderately deep to very deep, nearly level soils that are well drained to somewhat excessively drained. These soils formed in alluvium from metavolcanic, sedimentary, and metamorphosed sedimentary (schistose) rocks. They are in the northeastern part of the county on young alluvial fans of Stony Creek and in the foothills on low benches along Stony Creek and its tributaries. The vegetation was annual grasses and forbs and open stands of valley oaks. Elevations range from 125 to 1,200 feet, and average annual rainfall is 16 to 25 inches.

The surface layer characteristically is grayish brown, medium textured, and slightly acid. The subsoil is similar in color, but it is slightly finer textured and is slightly acid or neutral. Below is light yellowish-brown, medium-textured, moderately alkaline and calcareous material. A few areas are slightly gravelly or overlie sand and gravel at a variable depth. In small areas south of Hamilton City, the soils are affected by excess salts and alkali.

Most areas of Wyo soils are irrigated, and these soils are well suited to all row, field, orchard, and truck crops grown in the county.

Wyo silt loam (0 to 2 percent slopes) (Wn).—This very deep, well-drained soil is on young alluvium along Stony Creek and its major tributaries. It occupies a large acreage near Orland, Hamilton City, and Ordbend. The individual areas vary in size and shape, but most of them are quite large.

Representative profile:

0 to 11 inches, grayish-brown, hard silt loam that is dark grayish brown and friable when moist; massive or weak, subangular blocky structure; very slightly acid.

11 to 25 inches, grayish-brown, hard heavy silt loam that is very dark grayish brown and firm when moist; weak, angular blocky structure; dark grayish-brown organic stains on surfaces of peds; very slightly acid to neutral.

25 to 42 inches, grayish-brown, hard silt loam that is very dark grayish brown and firm when moist; massive; a few, dark grayish-brown organic stains; mildly alkaline.

42 to 60 inches +, light yellowish-brown, hard silt loam that is dark grayish brown and friable when moist; massive; moderately alkaline and slightly calcareous to moderately calcareous; lime is finely disseminated.

The surface layer is grayish brown or light grayish brown and is slightly acid to neutral. In some places, the uppermost one-half inch has a weak, platy structure. The subsoil is dark grayish-brown heavy silt loam or light silty clay loam that is grayish brown when crushed or broken. This material is very slightly acid or neutral, but it is mildly alkaline or moderately alkaline with increasing depth. In places lime occurs in the lower part. The substratum is light yellowish-brown or light olive-brown silt loam or loam and is mildly alkaline or moderately alkaline and slightly calcareous.

Permeability is generally moderate, but it is slow or very slow in some areas that have a traffic pan or a plowpan. Runoff is very slow to slow. The available moisture holding capacity is 9 to 11 inches. Fertility is high.

This soil is well suited to all irrigated field, row, truck, and orchard crops grown in the county. A small acreage generally is dryfarmed to milo or barley. A traffic pan or plowpan readily forms if this soil is cultivated when too wet or if oranges or similar crops are hauled from the field before the soil is dry. Because of such pans, penetration of water is slowed in some areas. Capability unit I–1.

Wyo loam, deep over gravel (0 to 2 percent slopes) (Wg).—This soil is slightly coarser textured when Wyo silt loam and is also shallower. It contains a few pea-sized pebbles and overlies sand and gravel at a depth of 42 to 60 inches. Permeability is moderate to the underlying sand and gravel, and then it is rapid. The water-holding capacity is 6 to 8 inches.

Areas of this soil vary in size. They generally are somewhat narrow and are near areas of Wyo silt loam. This soil is used for the same crops as Wyo silt loam. Capability unit IIs–0.

Wyo gravelly loam, moderately deep over gravel (0 to 1 percent slopes) (Wh).—This soil is more gravelly and is shallower than Wyo loam, deep over gravel. Depth to underlying gravel is 20 to 40 inches. Permeability is moderate to moderately slow in the solum and rapid to very rapid in the underlying sand and gravel. The available water holding capacity is 3 to 5 inches.

Most of this soil is irrigated. The principal crops are alfalfa, almonds, oranges, milo, and corn. Dryfarmed areas are used for grain or for range. Capability unit IIIs–4.

Wyo gravelly clay loam (0 to 1 percent slopes) (Wm).—This soil is slightly finer textured than Wyo silt loam and is gravelly throughout. Permeability is moderate. The available moisture holding capacity is 6 to 8 inches.

All of this soil is well suited to irrigated field, row, and orchard crops, but some areas are dryfarmed to barley. Capability unit IIs–4.

Wyo silt loam, moderately deep over clay (0 to 1 percent slopes) (Wo).—This soil is northwest of Hamilton City, adjacent to a basin area of Clear Lake clay. It overlies material like that of Clear Lake clay at a depth of 24 to 40 inches. Permeability is moderate to the underlying clay, and very slow in the clay. The available moisture holding capacity is 9 to 10 inches. The Wyo soil is well drained, but the underlying clay soil is slowly drained.

Shallow or moderately deep rooted field, forage, and row crops are well suited to this soil. Tree crops that are suitable for planting are those that tolerate restricted subsoil drainage. Capability unit IIIs–3.

Wyo silt loam, deep over claypan (0 to 1 percent slopes) (Wp).—This soil overlies material like that of Hillgate loam at a depth of 20 to 40 inches. The Wyo soil is moderately permeable, but the underlying soil is very slowly permeable. The available moisture holding capacity is 8 to 10 inches. A traffic pan or plowpan forms readily in the Wyo soil.

Shallow and moderately deep rooted, irrigated field, forage, row, and tree crops are well suited to this soil. Capability unit IIs–3.

Wyo silt loam, slightly saline-alkali (0 to 1 percent slopes) (Wsa).—From 5 to 15 percent of the area of this soil is affected by excess salts and alkali.

This soil is well suited to irrigated field, forage, and row crops that tolerate excess salts and alkali. Capability unit IIs–6.

Wyo silt loam, water table (0 to 1 percent slopes) (Wsw).—This soil has an intermittent high water table for short periods in winter and summer during the irrigation season. A clay layer that is very slowly permeable underlies this soil at a depth of 7 to 10 feet and restricts vertical movement of water. Water from adjacent soils or from irrigation ditches moves horizontally into the lower part of the subsoil and substratum of this soil.

The intermittent high water table makes this soil better suited to shallow and moderately deep rooted, irrigated field, forage, and row crops than to other crops. Prunes, pears, and similar orchard crops that tolerate some wetness do well on this soil. A few areas are dryfarmed to barley or are used for range. Capability unit IIIw–3.

Yolo Series

In the Yolo series are nearly level, well-drained soils. These soils formed in recently deposited alluvium washed chiefly from upland soils on unaltered sandstone and shale. They are on flood plains along minor streams and on recent alluvial fans under annual grasses and forbs. Most areas are in narrow valleys in the foothills or along the eastern edge of the foothills at elevations of 100 to 1,200 feet. The average annual rainfall is 16 to 25 inches.

These soils have indistinct horizons. The surface layer is brown or grayish brown, medium or moderately fine textured, and slightly acid. Below is brown or yellowish-brown, medium or moderately fine textured material that is stratified in many places and is neutral to mildly alkaline with increasing depth. Lime occurs intermittently and generally is at a depth below 30 inches

Yolo soils are associated with soils of the Capay, Hillgate, Myers, Tehama, and Zamora series.

A wide variety of crops can be grown on the Yolo soils. Most areas are used for dryfarmed barley, safflower, and annual range because irrigation water is lacking. A small acreage is irrigated and is used for milo, corn, pasture plants, alfalfa, and sugarbeets.

Yolo clay loam (0 to 2 percent slopes) (Yc).—This soil is very deep and is free of salts and alkali.

Representative profile:

0 to 9 inches, brown to grayish-brown, hard clay loam that is dark brown to dark grayish brown and friable when moist; massive to weak, subangular blocky structure; slightly acid.

9 to 34 inches, brown, hard silty clay loam that is stratified with thin layers of loam, silt loam, and very fine sandy loam and is dark brown and friable when moist; massive; neutral to mildly alkaline.

34 to 60 inches +, pale-brown to light yellowish-brown, hard loam that is stratified with lenses of clay loam, fine sandy loam, and silt loam and is brown and friable when moist; mildly alkaline and intermittently calcareous.

The surface layer is brown or grayish-brown heavy loam or clay loam to silt loam that is slightly acid to neutral. Below is brown, pale-brown, or light yellowish-brown fine sandy loam, loam, clay loam, and silt loam to silty clay loam. This material is neutral to mildly alkaline. It is intermittently calcareous in the lower part, generally at a depth below 30 inches. In most places the subsoil is somewhat stratified.

Permeability is moderate. Runoff is slow, and the erosion hazard is very slight. Fertility is high. The available moisture holding capacity is 10 to 11 inches.

Included with this soil are small areas of soil that is calcareous throughout.

This Yolo soil is well suited to a wide variety of field, forage, row, and orchard crops. The areas are scattered throughout foothill valleys. Irrigation water is lacking, and most areas are therefore used for dryfarmed barley, hay, safflower, and range. Capability unit I–1.

Yolo clay loam, moderately deep over clay (0 to 2 percent slopes) (Yd).—This soil overlies material like that of Myers clay or Capay clay at a depth of 20 to 40 inches. Permeability is moderate in the Yolo clay loam and slow in the underlying clay. Runoff is slow, and the erosion hazard is very slight. Root penetration is deep, and the available moisture holding capacity is 9 to 11 inches.

Most of this soil is dryfarmed to barley and safflower or is used for annual range. If irrigation water is available, sugarbeets, alfalfa, milo, corn, and pasture plants grow well on this soil. Capability unit IIIs–3.

Yolo clay loam, deep over claypan (0 to 2 percent slopes) (Yf).—This soil overlies material like that of Hillgate loam at a depth of 20 to 40 inches. Depth to the claypan in the Hillgate material is more than 36 inches. Permeability is moderate in the Yolo clay loam and slow in the material below. Root penetration is moderately deep to deep.

Shallow and moderately deep rooted field, forage, and row crops are well suited to this soil. If irrigation water is available, milo, corn, sudangrass, sugarbeets, alfalfa, and pasture plants do well. Dryfarmed areas are used mostly as pasture for sheep and cattle in rotation with barley or safflower. Capability unit IIs–3.

Yolo clay loam, moderately deep over hardpan (0 to 2 percent slopes) (Yg).—This soil overlies material like Redding gravelly loam at a depth of 10 to 24 inches. Depth to the hardpan in the Redding material is 25 to 40 inches. Permeability is moderate in the Yolo clay loam and very slow in the Redding material. Runoff is slow, and the erosion hazard is very slight. The available moisture holding capacity is 5 to 7 inches. Root penetration is moderately deep.

This soil is used as range for sheep and cattle and for dryfarmed barley. If irrigation water were available, it would be well suited to pasture plants, ladino clover, milo, corn, and other shallow-rooted field and forage crops. Capability unit IIIs–3.

Yolo clay loam, shallow over clay (0 to 2 percent slopes) (Yh).—This soil overlies clay material like that of the Myers or Capay series at a depth of 10 to 24 inches.

Use is similar to that for Yolo clay loam, moderately deep over clay. Capability unit IIIs–3.

Yolo clay loam, slightly saline-alkali (0 to 2 percent slopes) (Ym).—This soil overlies material like that of Willows clay at a depth of 10 to 24 inches. From 5 to 20 percent of its surface area is slightly to strongly affected by salts and alkali. Permeability is moderate in the Yolo clay loam and very slow in the underlying clay.

This soil is associated with soils of the Willows series. It has a water table at a depth of 3 to 5 feet during the growing season. It is better suited to rice and pasture plants than to other crops, but such other irrigated crops as milo, corn, and sudangrass are also grown. Dryfarmed areas are used for annual range, barley, and safflower. Capability unit IIIw–5.

Yolo silt loam, silty clay loam substratum (0 to 2 percent slopes) (Yo).—This soil overlies material like that of Plaza silty clay loam at a depth of 10 to 24 inches. Permeability is moderate. Runoff is slow. Flooding is a hazard in some areas during the rainy season.

Most areas of this soil are adjacent to Walker Creek, northeast of Willows. The areas are used for dryfarmed barley and as range for sheep or cattle. Under irrigation, this soil is well suited to shallow and moderately deep rooted field and forage crops. Areas along Walker Creek need to be protected by levees to keep them from being flooded by large amounts of runoff in the rainy season. Capability unit IIs–3.

Yorkville Series

Soils of the Yorkville series are moderately deep to deep, sloping to very steep, and moderately well drained to somewhat poorly drained. They formed under annual grasses and forbs in material from sandstone and shale of the Franciscan formation. The sandstone and shale are partly metamorphosed and serpentinized along pressure faces. Slopes are irregular. Landslips are common. Elevations range from 2,000 to 3,500 feet, and the average annual precipitation is 30 to 55 inches.

The surface layer is gray or grayish-brown clay loam that is slightly acid to neutral. The subsoil is gray clay. It is mildly alkaline to moderately alkaline and is slightly calcareous. Gravel occurs throughout the profile. Depth to fractured bedrock ranges from 20 to 50 inches. In places rock outcrops are common.

These soils are associated mainly with the Henneke, Polebar, and Parrish soils.

Yorkville soils are used mainly for spring and summer grazing by livestock. They are also used for wildlife areas and for water supply.

Yorkville clay loam, 30 to 65 percent slopes (YvE).—This is the only Yorkville soil mapped in the county; it is in the mountains in the southwestern part. In some places rocks crop out, and in many places landslips are common.

Representative profile:

0 to 14 inches, gray, hard clay loam that is very dark gray and firm when moist; a few pebbles; coarse to very coarse, angular blocky structure; slightly acid, but neutral in the lower part.

14 to 38 inches, gray, very hard gravelly clay that is dark olive gray and very firm when moist; very coarse, subangular blocky structure; mildly alkaline and slightly calcareous.

38 inches +, hard, fractured, gray sandstone that is partly metamorphosed and serpentinized along pressure faces; a few calcite seams.

The surface layer generally is grayish-brown or gray clay loam or slightly gravelly clay loam. It is slightly acid to neutral. The subsoil generally is gray, grayish-brown, or olive-gray clay or gravelly clay. It is mildly alkaline to moderately alkaline and is calcareous. Gravel makes up 5 to 15 percent of the surface layer and 20 to 50 percent of the subsoil, by volume. Lime, which is finely disseminated and in many places is segregated, occurs in the lower part of the solum around pebbles and as coatings on the parent rock. Depth varies within a short distance. It ranges from about 20 inches to more than 50 inches, but the depth is dominantly 30 to 45 inches. Rock outcrops are common and in places occupy as much as 5 percent of the surface. Landslips also are common.

In some places springs or small seeps are in this Yorkville soil. Permeability is slow. Runoff is rapid to very rapid, and the erosion hazard is severe to very severe.

Most of this soil is used as spring and summer range for livestock. The areas also are used for wildlife and water supply. The steep slopes, unstable soil material, and many landslips make it hard to maintain roads through areas of this soil. Capability unit VIIe-3.

Zamora Series

Soils of the Zamora series are well drained to moderately well drained. They formed in alluvium from sedimentary rocks, mainly sandstone and shale, and in mixed alluvium from rocks from various sources. Some of these soils are on nearly level to very gently sloping, young alluvial fans and stream ridges along minor intermittent streams that drain areas in the foothills. Others are on nearly level, old flood plains along the Sacramento River. The vegetation is chiefly annual grasses and forbs, but valley oaks grow in a few places. Elevations range from 50 to 1,200 feet, and the average annual rainfall is 15 to 25 inches.

The surface layer is grayish-brown or dark grayish-brown, moderately fine textured, and slightly acid. The subsoil is similar in color, but it is slightly finer textured and is neutral to mildly alkaline. Below this is pale-brown, brown, or yellowish-brown, moderately fine textured and mildly alkaline material that is intermittently calcareous at a depth below 36 inches.

In valleys in the foothills, these soils are associated with soils of the Hillgate, Myers, and Yolo series. Along the Sacramento River, the soils occupy areas between the Columbia soils, on recent flood plains, and Marvin soils, on the rims of basins.

Zamora soils are used for a wide variety of crops. Dryfarmed areas are used chiefly for barley and safflower, or for range. Irrigated crops are chiefly milo, corn, sugarbeets, beans, alfalfa, walnuts, almonds, and prunes, but rice is grown in some places.

Zamora silty clay loam, 0 to 2 percent slopes (ZbA).—This very deep, well-drained soil occupies a large acreage on both sides of the Sacramento River, south of Ord Ferry. A smaller acreage is in narrow valleys in the foothills.

Representative profile:

0 to 11 inches, grayish-brown, hard silty clay loam that is very dark grayish brown and firm when moist; massive to weak, subangular blocky structure; slightly acid.
11 to 38 inches, grayish-brown, hard, heavy silty clay loam that is very dark grayish brown and firm when moist; weak to moderate, subangular blocky structure; dark colloidal stains on ped faces; neutral but becomes mildly alkaline with increasing depth.
38 to 60 inches +, pale-brown, hard silty clay loam that is dark brown and firm when moist; massive; moderately alkaline and slightly calcareous; lime is finely disseminated and also is segregated along the walls of tubular pores.

The surface layer is 10 to 20 inches thick. It is grayish-brown or dark grayish-brown clay loam or silty clay loam that is slightly acid or very slightly acid. The material below is similar in color, but it is heavy clay loam, heavy silty clay loam, or light silty clay that is neutral to mildly alkaline. It generally is 18 to 30 inches thick and overlies pale-brown, brown, or light yellowish-brown clay or silty clay loam that is mildly alkaline to moderately alkaline and is intermittently calcareous. The soils in the foothills have a brownish cast, and those along the Sacramento River have a grayish cast.

Except for areas in the district of Jacinto-Glenn-Codora that are adjacent to areas in rice and have an intermittent high water table during the ricegrowing season, this soil is well drained. Permeability is moderately slow. Runoff is very slow, and the erosion hazard is very slight. The available water holding capacity is 10 to 12 inches. Root penetration is deep to very deep, and fertility is high.

Included with this soil are small areas of Myers and Yolo soils. Also included are less extensive areas of Marvin soils.

Because irrigation water is lacking, areas of this soil in valleys in the foothills are generally used for small grain and annual range. A small acreage in Clark Valley is used for dryfarmed alfalfa. West of Willows, along the eastern edge of the foothills, most areas of this soil are part of large holdings and are used mainly for dryfarmed barley in rotation with pasture, though a small acreage is used for irrigated sugarbeets, milo, and alfalfa. The largest acreage of this soil occupies areas on both sides of the Sacramento River. Here the areas are dryfarmed or are irrigated. Barley, safflower, and annual native range are the chief dryfarmed uses. Irrigated crops are chiefly milo, corn, pasture plants, sugarbeets, beans, almonds, walnuts (fig. 9), and prunes, but rice is grown in places. In some areas along the Southern Pacific Railroad, between Jacinto and Princeton, which are adjacent to areas in rice, the water table is intermittently high during the ricegrowing season. Capability unit I-1.

Zamora silty clay, 0 to 2 percent slopes (Zc).—This soil is on low stream ridges near Willows. It is light silty clay throughout and generally is free of lime. Permeability is slow. Runoff is also slow, and the erosion hazard is slight.

This soil is used chiefly for dryfarmed barley and range. It is well suited to a variety of crops, and under irrigation, sugarbeets, alfalfa, orchard crops, milo, corn, and other field crops can be grown. Capability unit I-1.

Figure 9.—**Orchard of young walnut trees on Zamora silty clay loam, 0 to 2 percent slopes.**

Zamora silty clay loam, 2 to 8 percent slopes (ZbB).—This soil is in the eastern part of the county on small alluvial fans in narrow valleys in the foothills and along minor drainageways. Runoff is slow, and the erosion hazard is slight. Areas in the valleys generally are free of lime.

Most areas of this soil are used for dryfarmed barley or wheat and range. Water is lacking in most places in the foothill valleys, and it is not likely that these areas will be irrigated. The chance of rain in spring is uncertain and fertilizer therefore should not be used on dryfarmed crops. Capability unit IIe–1.

Zamora silty clay loam, deep over hardpan, 0 to 2 percent slopes (Zc).—This soil overlies material like Landlow clay at a depth of 30 to 40 inches. Depth to the hardpan in the clay is more than 54 inches. Permeability is moderately slow in the Zamora silty clay loam and very slow in the Landlow material. Runoff is very slow, and the erosion hazard is very slight.

This soil occupies narrow areas in the eastern part of the county adjacent to Angel Slough and Campbell Slough. It is used chiefly for dryfarmed grain and milo or is used for rice. A few areas have been used for irrigated pasture or alfalfa for a short time. Capability unit IIs–3.

Zamora silty clay loam, deep over silty clay, 0 to 2 percent slopes (Zd).—This soil is on an old flood plain, south of Jacinto, on both sides of the Sacramento River. It overlies material like Marvin soils at a depth of 25 to 40 inches. Depth to silty clay in the Marvin material generally is 36 to 54 inches.

Dryfarmed areas of this soil are used for barley, safflower, and range. Irrigated crops are chiefly pasture plants, milo, corn, alfalfa, almonds, prunes, and walnuts, but rice is grown in places. Areas that border fields in rice have an intermittent water table at a depth of 3 to 5 feet, during the ricegrowing season. Other use is similar to that for Zamora silty clay loam, 0 to 2 percent slopes. Capability unit IIs–3.

Zamora silty clay loam, slightly saline-alkali, 0 to 2 percent slopes (Zma).—This moderately well drained soil is less well drained than Zamora silty clay loam, 0 to 2 percent slopes, and 5 to 20 percent of the surface area is slightly to strongly affected by salts and alkali. In places

relict strong-brown mottles are in the lower part of the subsoil and in the substratum.

This soil generally is near saline-alkali free areas of Zamora silty clay loam, 0 to 2 percent slopes, and is used for the same general crops. Stands of the crops grown are uneven because of the saline-alkali affected areas. These saline-alkali areas can be reclaimed through use of soil amendments and deep leaching if deep drainage ditches are provided to remove the water used in leaching. Many areas of these soils are difficult and expensive to reclaim, especially those areas adjacent to ricefields, where the water table is intermittently high. Capability unit IIs–6.

Zamora silty clay loam, moderately saline-alkali, 0 to 2 percent slopes (Zmb).—From 20 to 50 percent of the surface area of this soil is slightly to strongly affected by excess salts and exchangeable sodium, but it is otherwise similar to Zamora silty clay loam, slightly saline-alkali, 0 to 2 percent slopes. It is in slightly depressed areas near areas of Zamora silty clay loam that are slightly saline-alkali or that are free of salts and alkali.

Dryfarmed areas of this soil are used for barley, safflower, and range. Irrigated crops are milo, corn, pasture plants, alfalfa, and rice. It is difficult and expensive to reclaim areas of this soil because of the intermittent high water table during the ricegrowing season. Capability unit IIIw–6.

Use and Management of the Soils

In this section the capability grouping used by the Soil Conservation Service is explained and suggestions for managing soils in each capability group are given. Then management of the more important crops in the county is discussed, results of fertility studies are described, and a brief discussion of saline-alkali soils is given. Following this the estimated yield of the soils for the more important crops in the county and the Storie index rating for each of the soils are listed. After that management of pasture and range and of brushland and woodland are described and engineering uses of the soils are discussed.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to horticultural crops, or to rice and other crops that have their own special requirements for economical production. The soils are classified according to degree and kind of permanent limitation, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

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

Class I. Soils in class I have few limitations that restrict their use.

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

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

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

Class V. Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Class VIII. Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to 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 risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is 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 the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, 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 other than class I are given numbers that indicate the chief kind of limitation responsible for placement of the soils in the capability class and subclass. For this reason some of the units within the subclasses are not numbered consecutively. Their symbols are a partial key to some of the soil features. In the California system all capability units in class I are numbered thus: I–1. The Arabic numeral simply identifies the capability unit. The numerals used to

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